CT FINDINGS OF SMALL BOWEL NEOPLASMS

Sebastián Giménez, Gustavo Raichholz, Cristian Froullet, Santiago Dumoulin, Hernán Brouver de König, José Luis Sañudo.

Resumen
Las neoplasias de intestino delgado son lesiones poco frecuentes, representando menos del 5% de los tumores del tracto gastrointestinal (GI). Ante un tumor de intestino delgado, el diagnóstico diferencial suele ser amplio, sin embargo algunas de estas lesiones presentan características típicas en tomografía computada (TC) que sugieren su diagnóstico. Los tumores del estroma gastrointestinal (GIST), se presentan en TC como masas de comportamiento exofítico, redondeadas, con realce heterogéneo. Los adenocarcinomas de intestino delgado pueden manifestarse como una lesión estenosante, un pequeño nódulo o una lesión ulcerativa. Una masa en la raíz del mesenterio, de bordes espiculados, es la presentación común de las adenopatías de los tumores carcionoides. La dilatación aneurismática de un asa, con engrosa-

Abstract
Neoplasms of the small bowel are rare lesions, representing less than 5% of tumors of the gastrointestinal (GI) tract. In the presence of a small bowel tumor, the differential diagnosis is often broad; however some of these lesions have typical characteristics in computed tomography (CT) that suggest its diagnosis. Gastrointestinal stromal tumors (GIST) are presented in CT as exophytic rounded masses with heterogeneous enhancement. Small bowel adenocarcinomas may manifest as a stenotic lesion, a small nodule or an ulcerative lesion. A mass of spiculated edges in the mesenteric root is the common presentation of lymph nodes of carcinoid tumors. Lymphomas frequently present aneurysmal dilatation of a loop with circumferential wall thickening. Lipomas are displayed as nodular lesions, with values similar to fat attenuation. The most
Introduction
Neoplasms of the small bowel are rare lesions, representing less than 5% of tumors of the gastrointestinal tract (GIT). When there are tumors in the small bowel, differential diagnosis is often broad. However, many of these tumors display typical characteristics in CT that help to reach a diagnosis (1).

The role of the radiologist is to determine the location and extension of the lesion, the presence of metastatic lesions and to reach a pre-surgical diagnosis. Also, CT helps to detect complications associated with these tumors, such as digestive hemorrhage, obstruction and intestinal perforation. This information is very useful to plan a pre- and post-surgical therapy for these patients.

Gastrointestinal stromal tumors (GIST)
Currently, they represent the most common non-epithelial tumors of the GIT. They derive from the interstitial cells of Cajal, present in the myenteric plexus of the smooth muscle and are clearly different from other mesenchymal tumors, such as leiomyoma and leiomyosarcoma. 95% of these tumors express the receptor CD117 (KIT). Therefore, the identification of this tyrosine-protein kinase receptor is key to make a histopathologic diagnosis of GIST (2).

They are infrequent in patients younger than 40 years old. They appear in elderly patients, except when associated with predisposing syndromes, such as Neurofibromatosis type I.

Its location is more frequent in the stomach (42%), followed by the small bowel (37%), but they can be present in any portion of the GIT. They can even appear in the peritoneum, which is the most infrequent location (2).

In CT, these tumors appear as masses of soft tissue density that originate in the gastrointestinal wall and can protrude towards the lumen or present a predominantly exophytic growth. The size is very variable, from a few centimeters to voluminous masses that can measure more than 30 cm. Generally, they are hypervascular, with a heterogeneous enhancement after intravenous contrast due to the presence of central necrosis or hemorrhage (Figure 1). They can ulcerate towards the lumen of the organ, allowing the passage of positive endoluminal contrast towards the necrotic cavity of the tumor. With less frequency, they appear as cystic masses (3) (Figure 2).
Most GISTs are benign; however, imaging methods are not useful to determine if a lesion is benign or malignant, except in cases where they present distant metastases. The presence of necrosis is not a reliable indicator of the aggressiveness of these tumors (4). The diagnosis of malignancy of these lesions is reached through histopathologic criteria, such as the number of mitosis (>10 per high power field), the size of the lesion (>5 cm), the presence of metastasis, and the location. Malignant GISTs of the small bowel are more frequent than gastric tumors (5).

**Figure 1. GIST.**
CT axial image in arterial phase (A) shows a hypervascular lesion (thick white arrow), of exophytic growth with heterogeneous enhancement due to the presence of necrosis (think black arrow), in contact with a loop of the proximal jejunum. Axial views (B) with positive oral contrast help identifying the origin of the masses of soft tissue (thick white arrow) in the bowel wall (think white arrow).

**Figure 2. Cystic GIST.**
CT axial image in arterial phase (A) and coronal image in portal venous phase (B). Cystic, exophytic voluminous formation (thick white arrow), in contact with a jejunal loop (thin white arrow). There is a parietal nodular lesion in the jejunal loop showing hyper-enhancement (thin black arrow). Inside the cystic cavity, there is a hydro-air level that accounts for the communication with the intestinal lumen (arrow head).
Adenocarcinoma

Small bowel adenocarcinomas are also infrequent tumors, representing only 0.5% of GIT neoplasms. However, it is the most frequent malignant tumor of the duodenum. Almost 50% of these tumors have this topography, especially close to the ampulla of Vater. The remaining cases appear in the jejunum and with less frequency in the ileum (4).

Most cases are sporadic and they predominate in male patients. The incidence is greater between the ages of 70 and 90, with a mean age of 65 years old. Among risk factors there are diseases like celiac disease, Crohn's disease, history of colorectal cancer, Peutz-Jeghers Syndrome, and familial adenomatous polyposis (6).

In cases associated with Crohn's disease, 70% are present in the distal ileum.

These tumors can be present in CT as a circumferential stenotic, irregular lesion and with an abrupt origin, or as a polypoid or ulcerative lesion. There are also cases of diffuse parietal infiltration without narrowing of the organ lumen (Figures 3 and 4). They can have heterogeneous enhancement after e-v contrast injection. Besides, they can reduce the intestinal lumen until and produce a lumen obstruction. In the case of polypoid lesions, they can produce a mechanic ileum with less frequency by obstruction secondary to an invagination, acting as the head of the intussusception.

Carcinoid tumors

The small bowel is the most frequent location site of gastrointestinal carcinoid tumors. They derive from enterochromaffin cells of Kulchitsky, producers of serotonin of the distal ileum, the most common location of this tumor.

The majority of these tumors are sporadic, but a small number of them is associated with the hereditary syndrome of Multiple Endocrine Neoplasia type 1 (7).

Even though its biological behavior is variable, they are generally malignant lesions with the capacity to produce local lymph node and liver metastasis. They represent the most frequent malignant tumor of the small bowel.

Its incidence is similar in men and women with a mean age of 65 years old.

When they produce symptoms, they can be secondary to local effects of the primary tumors (obstruction, intestinal ischemia or bleeding) or due to hepatic metastases (carcinoid syndrome).

The primary tumor often appears as a small isolated or multiple nodular lesion that rarely measures more than 3.5 cm or as a circumferential parietal thickening, presenting in both cases a hyper-enhancement with intravenous contrast (Figures 5 and 6).

On the other side, metastatic lesions in mesenteric lymph nodes or in the liver are often of a greater size than the primary lesion (1).

The typical aspect of lymph nodes metastasis of the mesenteric root consists of spiculated masses, often calcified, accompanied by an extensive desmoplastic reaction of the mesenteric fat (Figure 5). This reaction is caused by the local production of serotonin and occasionally, it can be significant in the primary tumor, extending towards the adjacent mesenterium and determining a curve of the intestinal wall called “hairpin turn” (7).

Primary gastrointestinal lymphoma

Primary lymphoma of the GIT is the most common type of extranodal lymphoma. In most cases, it is non-Hodgkin type. Its most frequent location is the stomach, but it can affect any part of the gastrointestinal tract. It represents around 10% of all malignant tumors of the small bowel, being the third malignant most common neoplasm of that organ (8).

Two thirds of these tumors are type B cells and are located in the distal ileum. The remaining one third is composed by T cells and affects the duodenum and the jejunum with less frequency (4). It appears in adults, with a greater incidence in the seventieth decade of life, and 60% of patients are male (6).

The main risk factors for the development of this entity are celiac disease, inflammatory bowel disease, immunodeficiency syndromes and immunosuppression after solid organ transplantation.

Its preferential location is the distal ileum due to the existence of multiple lymphoid follicles (Peyer's patches) in the submucosa layer.

In CT, it can be seen as an infiltrating pattern that produces a diffuse thickening of the wall, destruction
of normal folds and aneurysmatic dilatation of the lumen due to the replacement of the muscle lumen that affects the autonomic plexus causing inhibition of peristalsis (Figure 7). Other types of presentation include: a unique intraluminal tumoral lesion, a great exophytic mass that can ulcerate and simulate a GIST or in the form of multiple small submucosal nodules.

Generally, they are accompanied by mesenteric and retroperitoneal adenopathies (6). Most of these neoplasms are soft tumors that do not cause obstruction of blood vessels nor of the bowel lumen. The most frequent complication of these tumors is perforation (4).

**Figure 3. Jejunum adenocarcinoma.**
Entero-graphic CT in portal venous phase, axial (A) and coronal (B) views, with evidence of distal jejunum, and presence of an infiltrating parietal lesion (arrow), affecting more than half of the organ circumference, without stenosis of the bowel lumen.

**Figure 4. Distal ileum adenocarcinoma.**
74-Year-old patient with history of right hemicolecction due to colon cancer. CT hydro-enema showing the presence of circumferential parietal thickening of the distal ileum (arrow) that does not reduce the bowel lumen.
**Figure 5. Carcinoid tumor.**
Axial CT without contrast (A) and with intravenous contrast in arterial phase in axial (B) and coronal (C) views showing the formation of soft tissue (thick white arrow), with some hypervascular calcifications (arrow head) after contrast injection centered in the mesenteric root. It surrounds some arterial vessels (thin black arrow), which show a subtle reduction of its caliber. It is accompanied by an extensive desmoplastic reaction of the adjacent mesenteric fat (thin white arrow). Findings correspond to a lymphadenopathy of carcinoid tumor. In the coronal image (C), it can be seen a primary tumor as a parietal circumferential thickening at the proximal ileum level (black arrow).

**Figure 6. Carcinoid tumor of distal ileum.**
Axial images in arterial phase CT (A) and portal venous phase (B) showing a stenotic hypervascular lesion of the distal ileum (thick arrow), which determines a mechanic bowel obstruction. Regional adenopathy (thin white arrow) and distended ileum-jejenum loops with an important level of liquid into its lumen (arrow head). There is hypervascular metastasis (C) in the right hepatic lobule (arrow).
Lipomas

In most cases, small bowel lipomas are diagnosed incidentally in a CT study, since they are almost always asymptomatic. They appear with greater frequency in the duodenum and the ileum. Rarely, they can act as heads of invagination and cause bowel obstruction (4) (Figure 8).

The diagnosis is easy with CT. They consist of homogeneous intraluminal lesions that are well-circumscribed with attenuation values of -80 to -120 UH. Small bowel liposarcoma is an extremely rare entity (1).

Small bowel metastasis

They are the malignant lesions that affect the small bowel with greater frequency. It can be disseminated through contiguity, hematogenous or peritoneal spread (4).

Hematogenous metastasis can be originated from a melanoma or lung, breast or renal cell carcinoma. They are often presented as multiple nodular lesions in the anti-mesenteric edge of the small bowel (6).

Contiguity metastasis can be originated from colon (Figure 9), biliary or pancreatic tumors. The determination of the primary tumor can be difficult, but it is useful for the prognosis of the patient.

Peritoneal carcinomatosis can cause tumor deposits in the serous surface of the small bowel, especially in its mesenteric edge, and it is seen in mucinous carcinomas of the colon, ovary, breast and appendage (1).

Conclusion

CT helps to detect small bowel tumors and determine their extension, location, and specific characteristics in order to reach a pre-surgical diagnosis. Moreover, it is very useful for the diagnosis of complications associated with these neoplasms.
Figure 8. Ileo-ileal invagination due to lipoma.
Axial (A) and coronal (B) CT with intravenous contrast, showing an ileo-ileal invagination (thick arrow), due to the existence of a bowel lipoma acting as a head of intussusception (thin arrow).

Figure 9. Adenocarcinoma of the sigmoid colon extending towards the distal ileum.
Sagittal (A) and coronal (B) images in portal venous phase with evidence of a stenotic tumoral formation of the sigmoid colon (thick white arrow), with invasion of the ileal loop (black arrow).
Bibliography


