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Diagnosis and Categorization of Small Bowel Neoplasms: Role of Computed Tomography

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Abstract. A retrospective study of 35 patients with small bowel neoplams studied by computed tomography (CT) was performed. The tumor detection rate was 80%. Using the findings reported in the literature, an adequate histological diagnosis could be performed in 69% of the cases by CT. Lipomas, leiomyomas, leiomyosarcomas, and carcinoid tumors were well-recognized, but adenocarcinomas and lymphomas were often mistaken one for the other. An accurate preoperative staging was performed in 61% of the cases. CT failed to detect 75% of the invaded lymph nodes, 25% of the liver metastases, and 25% of the tumoral growth beyond the bowel wall. Despite major limitations in preoperative staging, a good detection rate and some features allowing a specific diagnosis advocate using CT along with the barium examination when clinical history suggests a small bowel tumor.

Key words: Small bowel, neoplasms – Small bowel, CT.

Primary small bowel neoplasms are infrequent and nonspecific in their clinical presentation. Computed tomography (CT) is then likely to present the initial opportunity to detect and categorize a tumor of the small intestine. Although many reports mention the findings on CT [1–9], large series of these uncommon neoplasms are seldom reported [10, 11].

The purpose of our study was to determine the following: (1) the CT patterns of small bowel neoplasms in order to determine criteria allowing for their categorization and (2) CT performance in the detection and preoperative staging of these tumors.

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Materials and Methods

We reviewed the records of our institution and found between January 1982 and September 1989, 35 patients with a diagnosis of small bowel tumor studied by CT. All but one duodenal lipoma were pathologically proven. They included 11 adenocarcinomas, nine lymphomas, six leiomyosarcomas, four carcinoid tumors, two lipomas, two leiomyomas, and one villous adenoma. Pathological proofs were obtained by surgical, endoscopic, or percutaneous biopsy in all but one asymptomatic lipoma. Eighteen patients had a surgical exploration. Patients' ages (24 men, 11 women) ranged from 34–89 years.

Twenty-one patients presented with a history of gastrointestinal tract hemorrhage, diarrhea, or early obstruction and 13 with fever, weight loss, abdominal mass, or abdominal pain. The last patient had a duodenal lipoma incidentally discovered during the staging of a breast adenocarcinoma.

All patients underwent CT and 24 of them a barium examination. CT was performed on a Siemens Somatom DRH or a GE CT/T 8800, after water-soluble contrast ingestion (600–1000 ml administered 1 h before the CT examination) and with intravenous contrast administration. Slices were 8- to 10-mm thick, and table increments were 10 or 15 mm. Barium examinations were obtained by administering at least 500 ml of barium by enteroclysis; examinations were always completed by air or water double-contrast.

Original reports of CT and barium examinations were collected in order to determine the tumor detection rate. Then, using the criteria reported in the literature [10–12], the CT findings were reported in each histological group, in order to collect features allowing a specific diagnosis.

Finally, initial stagings of the 18 malignant tumors operated on were compared with surgical findings, in order to evaluate the efficiency of CT in the determination of adjacent organ invasion, lymph node involvement, and liver metastases.

Nodes were considered invaded when their diameter was larger than 15 mm. Fat and adjacent organs were considered involved when encased by tumoral growth.

Results

Small Bowel Tumor Detection Rate

Review of original reports showed that abdominal CT was considered abnormal in all but one case.

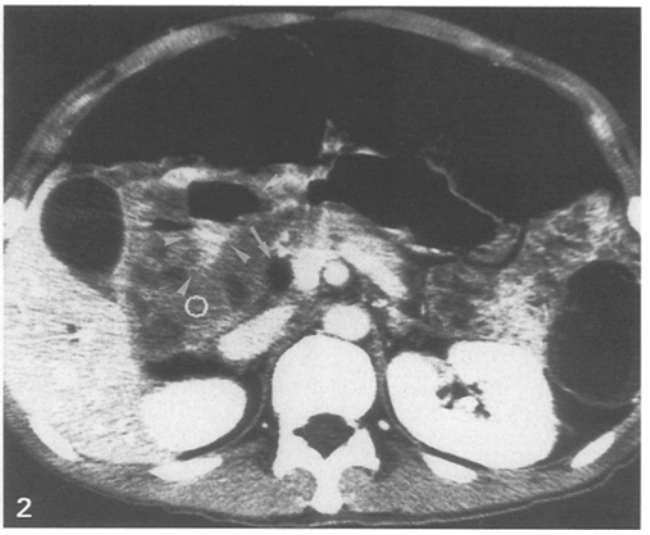

Fig. 1. Adenocarcinoma of the duodenojejunal junction: CT with intravenous contrast injection shows a large heterogeneous soft-tissue mass surrounding the bowel lumen (*arrowhead*) invading the mesentery and left mesocolon. Mesenteric vessels (*arrows*) are attracted close to the tumor which was surgically unresectable.

Fig. 2. Non-Hodgkin's lymphoma of the duodenum: CT with intravenous contrast injection shows an enlargment of the lumen of the second duodenum (*arrowheads*) surrounded by thickened walls (*circle*) giving an aneurysmal appearance. Note dilatation of the main bile duct (*arrow*) in the pancreas.

Fig. 3. Leiomyoma of the second duodenum: CT shows a mass eccentric from the bowel lumen (*star*). Its volume and relationships to adjacent organs are well-demonstrated. CT also shows its smooth contours and the hypodense central area (*arrowheads*).

The case missed by CT was a 2-cm jejunal adenocarcinoma. Among the 34 others, the tumor itself was seen in 28 cases (80%), and suspected in two cases showing retractile mesenteritis and mesenteric adenopathies. Three duodenal tumors were thought to be pancreatic neoplasms. The last patient had a thickened distal ileal wall which was considered to be an inflammatory mass because of a history of Crohn's disease. Biopsy performed under endoscopy revealed a lymphoma.

Among the 24 barium examinations, 21 (88%) were considered abnormal and three normal. The undetected tumors were an adenocarcinoma of the jejunum, a carcinoid tumor of the ileum, and a lymphoma of the ileum. All except the carcinoid tumor were seen on CT. The carcinoid tumor was diagnosed on the ancillary findings.

Categorization of Small Bowel Neoplasms

The CT findings of each histological type are reported as follows.

Adenocarcinomas (11 cases). Four were concentrically growing masses causing lumen narrowing and dilatation of proximal bowel segments. Tumors more than 3 cm in diameter had an extraluminal growth, as well as patterns suggesting infiltration of the mesenteric fat and adjacent organs (Fig. 1). Among these, four were homogeneous and four were heterogeneous with low-attenuation areas. The only finding in one patient was a 2-cm thick bowel wall. Two adenocarcinomas smaller than 2 cm were not seen.

Lymphomas (nine cases). Seven of them presented with a homogeneous thickened bowel wall

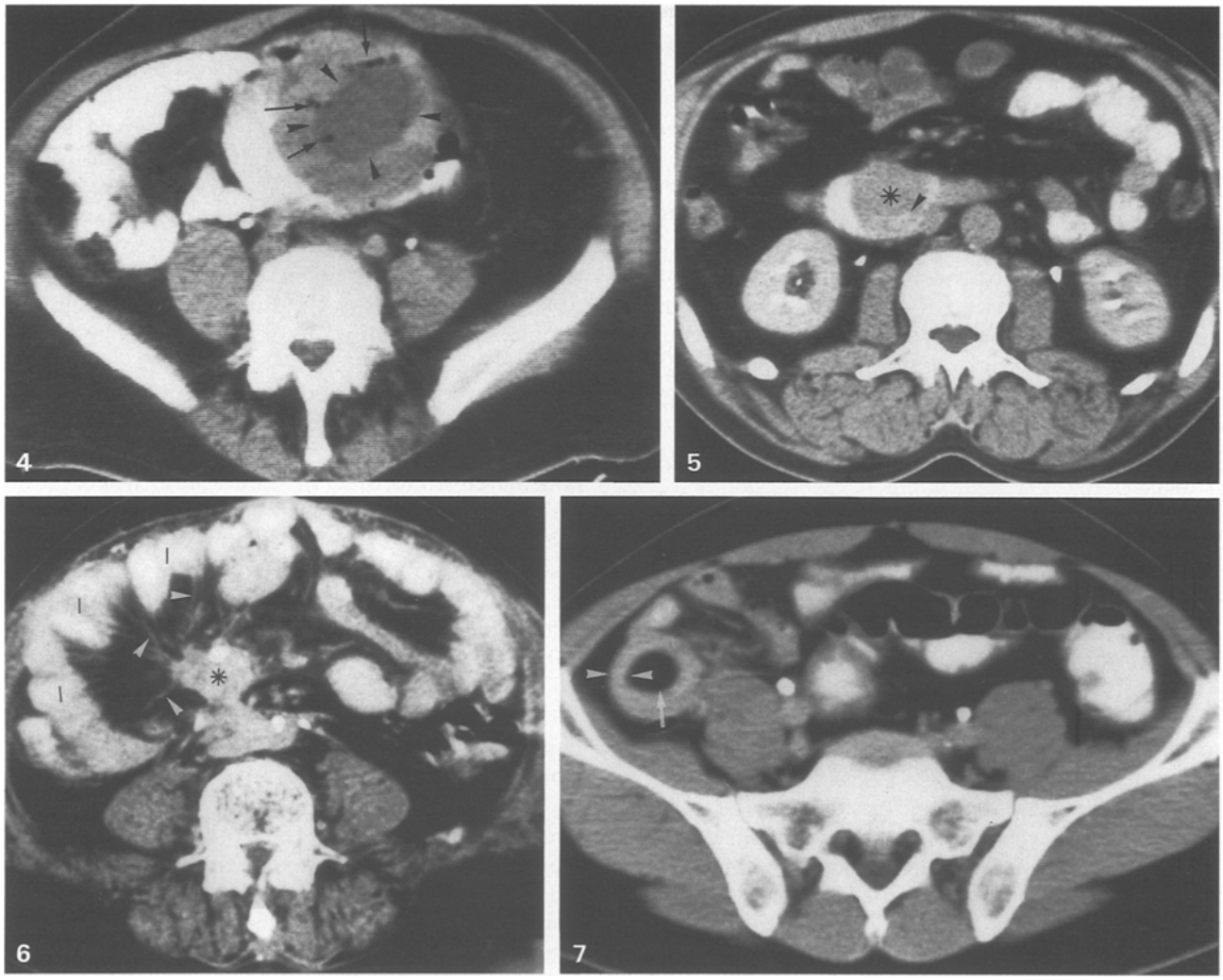

Fig. 4. Leiomyosarcoma of the proximal ileum: CT with intravenous contrast injection shows a large tumor (7 cm), which is mainly extraluminal. The central low-density area (*arrowheads*) is related to necrosis, and gas bubbles (*arrows*) indicate fistula which was confirmed by barium examination.

Fig. 5. Grade I leiomyosarcoma of the duodenum: CT with intravenous contrast injection. Homogeneous eccentric tumor (*star*) with smooth contours. The small dot of contrast (*arrowhead*) inside the lesion is due to tumor ulceration. Despite the smooth contours, the tumor was malignant and invaded the right mesocolon.

Fig. 6. Carcinoid tumor revealed by a carcinoid syndrome: CT after intravenous contrast injection shows a mesenteric calcified mass (*star*) with linear strands of the mesentery (*white arrowhead*) and small bowel loops draped around the mass (*I*).

Fig. 7. Lipoma of distal ileum: CT with intravenous contrast injection shows a fatty density mass (*arrow*) surrounded by thickened walls (*arrowhead*) related to intussusception.

greater than 2 cm with enlargement of the bowel lumen in four cases (Fig. 2) and narrowing in two. Two were bulky homogeneous masses, greater than 5 cm, branched on a bowel loop but mostly extraluminal.

Leiomyomas (two cases). They presented as eccentric masses, one (2 cm) was homogeneous, the other (4 cm) had a low-attenuation center (Fig. 3).

Leiomyosarcomas (six cases). All were eccentric tumors: five greater than 5 cm with low-attenuation centers (Fig. 4) and one smaller (3.5 cm) and homogeneous (Fig. 5). Intratumoral gas or barium due to tumoral ulceration was seen in two cases.

Carcinoid tumors (four cases). The tumors were seen in three cases as small-sized (less than 3 cm), homogeneous, ill-defined mesenteric masses (Fig. 6). Calcifications were present in two cases. Curvilinear soft-tissue strands of the mesentery, giving a stellate pattern with bowel loops draped around, were seen in three cases. These abnormali-

ties, which suggested a retractile mesenteritis, were the only findings in one case.

Lipomas (two cases). Lipomas were small tumors (2 and 3 cm), with characteristic fatty density. Intussusception was detected in one of them (Fig. 7).

Using the CT features described in the literature, it was possible to diagnose retrospectively a specific tumor type in 69% of the cases with CT and in 58% of the cases with barium examinations.

CT findings correctly diagnosed all lipomas and leiomyomas. Leiomyosarcomas and carcinoid tumors were correctly diagnosed in 83 and 75%, respectively. Lymphomas and adenocarcinomas were less frequently recognized (66 and 55%), respectively, and often one was mistaken for the other.

Local and Regional Extension

The accuracy of CT in preoperative staging was assessed in the 18 tumors surgically explored.

CT performed a correct staging in 11 cases (61%). It failed to detect invaded nodes (less than 15 mm) in two adenocarcinomas and in one lymphoma among four patients with proven lymph node involvement.

In eight patients, an extension of the tumor beyond the bowel wall was detected at surgical exploration. Invasion of the mesenteric fat and of the right mesocolon were missed in one adenocarcinoma and in one leiomyosarcoma. On the contrary, absence of fat surrounding the mesenteric vessels wrongly suggested their invasion in an adenocarcinoma of the third duodenum.

Small liver metastases were undetected in one leiomyosarcoma but correctly assessed in three other cases.

Discussion

Nowadays, CT is commonly used as a screening test in patients with symptoms evocative of a digestive tumor, or with vague abdominal symptoms. The performance of CT in the detection of small bowel neoplasms is then important to know. However, our study is retrospective, and small lesions could have been missed by both techniques (barium study and CT). Moreover, most of the CT studies were performed after barium examination. Therefore, a precise evaluation of the ability of CT to detect neoplasms cannot be drawn from this study.

Nevertheless, an important point is that CT was able to detect the three tumors missed by barium examination. The chance of detecting small bowel neoplasms is then probably increased while performing both techniques when the diagnosis is clinically strongly suspected.

This is why great care should be given to the technical procedure of CT. Uniform opacification of all the small bowel segments is necessary. In this purpose, scanning should be performed with contiguous slices not before 1 h after contrast loading has begun. Moreover, equivocal or questionable abnormalities seen during the examination should be investigated by repeated or delayed imaging [12].

According to the criteria of James et al. [13], any bowel wall thickness greater than 3 mm and mesenteric structures greater than 4 mm should be considered abnormal. In their study, when bowel wall or a mesenteric mass was greater than 1.5 cm, the accuracy of CT in the diagnosis of a neoplastic disease was 85%. All cases but one in our experience showed a wall thickness of greater than 1.5 cm. Combining our results with other reports [10–12], some CT patterns suggesting a histological diagnosis can be described.

Lipomas have fatty attenuation, which is the characteristic feature. They can cause intussusception [8, 9].

Leiomyomas and leiomyosarcomas have very characteristic patterns. They often form bulky lesions, growing eccentrically, and are sometimes calcified [2, 10]. The largest of them may have a low-attenuation center. Megibow et al. reported that this finding could suggest malignancy [4]. But we do have in our series as Farah et al. [11] a benign lesion with such a finding. Then, no feature seems characteristic, and malignancy should only be assessed when local invasion or metastases are present. Large ulcerations in the bowel lumen can happen, and should not be confused with an aneurysmal type of lymphoma.

The diagnosis of lymphoma can be suggested with a high confidence when homogeneous wall thickening greater than 2 cm is associated with a normal or enlarged lumen. This last finding mentioned as an aneurysmal ulceration [5, 10, 14] was the most frequent pattern detected in our experience.

Adenocarcinomas, in their typical presentation, are proximal solitary soft-tissue masses, causing lumen narrowing and obstruction [10, 12]. However, 45% of the cases have an atypical presentation when they are ulcerated, or located in the duodenum where they are difficult to differentiate from pancreatic tumors.

Carcinoid tumors have highly suggestive CT

patterns when radiating soft-tissue strands in the mesentery with displacement of the surrounding bowel loops are associated with a small-sized mesenteric mass of the right lower quadrant [1, 3, 6, 7, 15].

The primary tumor site may be difficult or impossible to locate on CT.

Retroperitoneal enlarged lymph nodes, liver metastases, or the tumor itself may be calcified.

Despite the low performance of CT, mainly in the evaluation of lymph node invasion, it remains the most accurate technique in the staging and follow-up of small bowel neoplasms.

In our experience, the value of CT is better in the determination of local invasion than in lymph node involvement. However, loss of fat planes surrounding a tumor are often difficult to interpret, and involvement of adjacent structures difficult to affirm, especially in juxtapancreatic tumors [11].

Our results suggest that CT, despite its limitations, has an important role to play in small bowel tumor evaluation. It enables the radiologist to assess the preoperative staging and to suggest, in some cases, a specific tumor type. It may also increase the chances of tumor detection, when performed with barium examination.

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