Multislice CT imaging of gastrointestinal stromal tumors (GISTs)

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Abstract  Objective: The purpose of this study is to investigate the anatomical and pathological features of the gastrointestinal stromal tumors.

Patients and methods: in the period between 2008 and 2010 multislice CT images of 32 patients affected by GIST were analyzed, the scanning was obtained before and after contrast medium injection also the bowel distension was obtained by the diluted gastrografin. Images were evaluated for presence, site and origin of the tumor as well as growth pattern relative to the bowel wall density, relationship with adjacent structures and presence or absence of lymph nodes and metastases.

Results: Thirty two patients with gists were identified (17 men and 15 women; mean age, 55.6 years). The primary tumor was located in the stomach in 14 cases, in the small intestine in 10 cases, in the ceacum and rectum in 5 and 3 cases, respectively. Mean primary tumor size was 14.3 cm (range from 2 to 18 cm). Tumors were typically with regular margins (12/32 cases, 37.5%), lobular (4/32 cases, 12.5%) while (16/32 cases, 50%) were irregular. Central fluid attenuation was seen in (15/32 cases, 49%). An extramucosal origin was definitely established in (28/32 cases, 87%). In (10/32 cases, 31.25%), the lesions exhibited extraluminal growth. Infiltration of...
1. Introduction

Gastrointestinal stromal tumors are rare and the term GIST, first used by Mazur and Clark in 1983, encompasses a heterogeneous group of nonepithelial neoplasms composed of spindle or epithelioid cells, which display a range of differentiation. There has been considerable debate in the literature regarding the nomenclature, origin, differentiation, and clinical behavior of these tumors (1,2).

Benign tumors can be discovered incidentally at surgery and are completely excised (3). The increasing use of computed tomography (CT) and endoscopy of the upper gastrointestinal tract is also a means for the detection of asymptomatic tumors. GISTs can originate anywhere along the gastrointestinal tract or beyond it in the mesentery or omentum (3,4). They typically arise in the bowel wall, usually from or between the muscularis propria and muscularis mucosa (4). Articles on the investigation of large series of GISTs have been published in the surgical and pathologic literature, but little emphasis has been placed on the specific radiologic appearances of these tumors. The purpose of this study is to investigate the anatomical and pathologic features of the gastrointestinal stromal tumors.

2. Patients and methods

We prospectively evaluated the CT images of 32 patients (17 men and 15 women, aged 40–77 years) in the period between 2008 and 2010. The definitive diagnosis was provided by histological examination of the surgical specimen. In 18 patients CT was needed to investigate its submucosal extension after endoscopy due to upper gastrointestinal bleeding. Among them 12 patients had the bleeding associated with anemia and dyspepsia. In eight cases, CT was performed for nonspecific symptoms of fatigue and weight loss, while three patients had a palpable abdominal mass. Finally, in three cases, GIST was an incidental finding on CT (during CT-enhanced examination performed for evaluation of the liver, showed no clinical symptoms related to the gastrointestinal tract).

3. Scanning protocol

CT scans were obtained by Asteion multidetector helical CT scanner (Toshiba Medical Systems, Tokyo, Japan). Axial images were obtained with 3.0-mm collimation, 16.5-mm table feeding per rotation, and 0.75-s gantry rotation time using a dual-phase protocol. The patients before the examination had been fasting for at least 6 hours and drinking 750 ml of water mixed with 40 ml gastrografin as an intraluminal contrast agent in order to obtain a dilation of the gastrointestinal tract.

After the initial standard scanning, a dose of 100 ml of iodinated nonionic contrast material (Ultravist 300, Schering, Guangzhou, China) was administered intravenously with an autoinjector (Medrad Vistron) at the rate of 3.0 ml/s. Dual-phase, contrast-enhanced scans were obtained at 30 and 60 s after the start of the injection during the dominant arterial and parenchymal phases, respectively. After acquisition and reconstruction of all the native high-resolution data set, MPVR was performed. Curved planar reformations and other three-dimensional reconstruction images of the mass were created.

The images were assessed for:

- Morphological changes to the intestinal wall caused by the presence of a recognizable, expansile mass in the wall.
- -Portion of the gastrointestinal tract involved by the tumor (stomach, duodenum, jejunum, ileum, colon and rectum).
- Tumor size, origin and growth pattern relative to the affected organ (defined as intra- or extraluminal, depending on whether more or less than half of the tumor lay inside or outside the lumen).
- Attenuation, defined as homogeneous or heterogeneous according to enhancement characteristics.
- Margin morphology of both mucosal and extramural components (regular if smooth or lobular; irregular if finely jagged).
- Presence of mucosal ulcerations at the lesion site.
- Relationship with adjacent structures or organs; infiltration was hypothesized in the absence of a clear cleavage plane.
- Presence of distant metastases.
- Evidence of lymph nodes; any node detected on the scans was considered pathological, regardless of diameter.
- Presence of ancillary findings, such as intestinal occlusion or ascites.

4. Results

Table 1 shows personal data of the studied groups where we have 32 patients (17 men and 15 women, aged 40–77 years).

Table 2 shows the clinical presentation of the studied group including GIT bleeding, anemia, weight loss, abdominal mass and incidental finding.

All the tumors in this group were single tumors. Fourteen cases originated from stomach (Figs. 1 and 2) in this order fundus, pyloric canal and then the cardia in 7, 4 and 3 cases, respectively. The disease involved the small intestine (Figs. 3 and 4) in ten cases and in the cecum (Figs. 5 and 6) and rectum in 5 and 3 cases, respectively (Table 3).
According to the growth pattern, of the 32 cases, 22 (68.75%) were intraluminal while in ten cases (31.25%) were extraluminal (Table 4).

Tumor diameter ranged from a minimum of 2 cm to a maximum of 18 cm (mean 14.3 cm). In detail, gastric lesions ranged from 2 to 17 cm (mean 9.3 cm), intestinal lesions from 3 to 16 cm (mean 9.5 cm), and the mean rectal lesion was 7.5 cm (Table 5).

In 28 cases (87.2%) GISTs were originated in muscularis propria while in four cases (12.8%) GISTs originated in muscularis mucosa (Table 6).

Extra-mucosal origin of the tumors had occurred in 28 of 32 cases and suggested by the presence of raised mucosa at the lesion site.

Tumors were typically with regular margins (12/32 cases, 37.5%), lobular (4/32 cases, 12.5%) while (16/32 cases, 50%) were irregular (Table 7).

Table 1 Sociodemographic data.

<table>
<thead>
<tr>
<th>Gender (total n = 32)</th>
<th>17 males (54%) and 15 females (46%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at investigation</td>
<td>40–77 (mean 55 ± 3.6)</td>
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</tbody>
</table>

Table 2 Clinical presentation at time of investigation.

<table>
<thead>
<tr>
<th>Presentation</th>
<th>Number of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bleeding</td>
<td>18</td>
</tr>
<tr>
<td>Anemia (after bleeding)</td>
<td>12</td>
</tr>
<tr>
<td>Weight loss</td>
<td>8</td>
</tr>
<tr>
<td>Abdominal mass</td>
<td>3</td>
</tr>
<tr>
<td>Incidental</td>
<td>3</td>
</tr>
</tbody>
</table>

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Presence of mucosal ulcerations at the lesion site was detected in (9/32 cases, 28%).

Infiltration of the adjacent structures was observed in (20/32 cases, 62.5%) where there was absence of the cleavage plane.
The tumoral mass appeared on CT scans as homogeneous hypoattenuated density in 8 and in 24 as heterogeneous density. Fifteen tumors showed central massive hypoattenuation of fluid density. After the intravenous injection of a contrast agent, the tumors showed irregular heterogeneous enhancement. In one patient, internal vessels were detected during the arterial dominant phase.

At presentation, metastatic foci were detected in 9 patients; 4 in the liver, three cases and in the omentum (Fig. 7). The hepatic metastases appeared as focal masses with (Fig. 8) heterogeneous enhancement in the parenchymal stage. In the patients with metastases to the omentum, CT scans revealed an increase omental density. Lymphadenomegaly was observed in two cases (Table 8).

According to ancillary findings there were intestinal obstruction in 3 cases and ascites in only one patient. All tumors confirmed by histopathological examination to be GISTs after surgery.
5. Discussion

The term gastrointestinal stromal tumor (GIST) has traditionally been used as a descriptive term for soft-tissue tumors of the gastrointestinal tract. Although their exact incidence is still somewhat unclear, it is now estimated that between 5,000 and 10,000 people each year develop GISTs in the world; men and women are equally affected (5). GISTs were previously thought to be smooth muscle neoplasms, and most were classified as leiomyosarcoma. With the advent of immunohistochemistry and electron microscopy, it has become apparent that GIST may have myogenic features (smooth muscle GIST), neural attributes (gastrointestinal autonomic nerve tumor), characteristics of both muscle and nerve (mixed GIST) or may lack differentiation (GIST not otherwise specified) (6). GISTs are often discovered incidentally at surgery and should be completely excised. The increasing use of computed tomography (CT) and endoscopy of the upper gastrointestinal tract is a non-or minimally invasive means for the detection of asymptomatic GISTs (7).

Imaging examination plays an important role in preoperative diagnosis and postoperative evaluation for GIST (8). Multislice spiral CT is valuable in the diagnosis of malignant GIST (9).

In the present study, the mean age at presentation was over 50 years, as that in other series (10,11). Male predominance is a feature in most previous studies (12,13) but is usually less marked than the nearly in our study.

GISTs can arise from the wall of any portion of the gastrointestinal tract, from the esophagus to the anus (14) and represent the most common type of mesenchymal tumor, if we exclude the esophagus, 25% are GISTs and 75% are leiomyomas (14,15). The GIST locations found in our study (stomach 43.75%, small intestine 31.25%, cecum 15.6% and rectum 9.3% reflect the data reported in the literature (16,17).

Tumor size varies from millimeters which generally an incidentally discovered to 30 cm or more (18,19). In the present study, tumor diameter ranged from a minimum 2 cm to a maximum of 18 cm (mean 14.3 cm). In detail, gastric lesions ranged from 2 to 17 cm (mean 9.3 cm), intestinal lesions from 3 to 16 cm (mean 9.5 cm), and the mean rectal lesion was 7.5 cm.

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Table 6  Tumor origin.

<table>
<thead>
<tr>
<th>Origin</th>
<th>Incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muscularis propria</td>
<td>28 (87.2%)</td>
</tr>
<tr>
<td>Muscularis mucosa</td>
<td>4 (12.8%)</td>
</tr>
</tbody>
</table>

Table 7  Tumor margin.

<table>
<thead>
<tr>
<th>Site</th>
<th>Incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular</td>
<td>12 (37.5%)</td>
</tr>
<tr>
<td>Lobular</td>
<td>4 (12.5%)</td>
</tr>
<tr>
<td>Irregular</td>
<td>16 (50%)</td>
</tr>
</tbody>
</table>

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Table 8  Distribution of the metastases.

<table>
<thead>
<tr>
<th>Site</th>
<th>Number of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liver</td>
<td>4</td>
</tr>
<tr>
<td>Omentum</td>
<td>3</td>
</tr>
<tr>
<td>Lymph nodes</td>
<td>2</td>
</tr>
<tr>
<td>Bone</td>
<td>0</td>
</tr>
<tr>
<td>Lung</td>
<td>0</td>
</tr>
</tbody>
</table>

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Figure 7  MSCT axial scan of the upper abdomen shows GIST mass at the small bowel with omental deposit.

Figure 8  MSCT axial scan of the upper abdomen shows GIST mass at the stomach with 2 small liver metastases.
In the line of the study done where the GISTs often originate in muscularis propria (outer wall layers) while those arising in the muscularis mucosa (deeper wall layers) are rare and more frequently involve the colon (2). In our study, in 28 cases (87.2%) GISTs were originated in muscularis propria while in four cases (12.8%) GISTs originated in muscularis mucosa.

The stomach and small bowel consistently account for the vast majority of cases of GIST, usually with a division that favors the stomach (20,21). Multiplicity of primary tumors is rare (21,22). However, tumors arising outside the bowel wall constitute up 10% of cases (23). In the present study the most common site of primary tumors as we had found in the stomach versus other studies where the small bowel rather than the stomach was the most common primary site (20,21). A possible explanation for the other finding could be the misclassification of a number of mesenteric and omental tumors as being of small-bowel origin, a theory supported by the large proportion of extraluminal tumors.

Regarding to tumor behavior tumors of small-bowel origin tend to have more aggressive behavior and thus a worse prognosis than that of tumors originating in other gastrointestinal sites (22,23) this agree our results where the presentation of most small bowel tumors associated with metastasis either to the omentum or the liver.

Regarding the most common symptoms of these tumors still there is wide discrepancy about it, we had most commonly gastrointestinal bleeding in 56.25% or signs and symptoms of anemia caused by occult bleeding. In other reports, the most common symptoms was abdominal pain (23,24). Features at clinical presentation are dependent on tumor size. Small tumors are usually an incidental surgical finding (24), as we had in three cases, while large tumors are usually symptomatic including gastrointestinal hemorrhage, often with an acute episode, abdominal pain, a mass, weight loss, nausea, and vomiting (24). Many GISTs are incidentally found during a periodic medical check-up. Tumors found incidentally, which have a better prognosis, have a mean diameter of 2.5 cm (25).

We had three cases (9.3%) with intestinal obstruction at presentation, other series revealed small bowel obstruction reported in up to 30% (26) but accounts for less than 10% of presentations in most reports (27,28) and other findings, which also show such obstructions to be rare, even in advanced metastatic disease (29,30).

The rarity of ascites suggests that these tumors do not incite a local inflammatory reaction. The occurrence of ascites at follow-up is likely, due at least in part to treatment (31). In our study we reported only one case with ascites.

Endoluminal tumors will result in symptoms sooner, with a greater expectation for curative surgery (31). Our referral pattern also accounts for the high rate of metastases at presentation, however, the incidence of metastases at presentation in the largest clinical series (3) of malignant GISTs approached 50%.

The development of local recurrence and metastases at follow-up is a feature of this disease. The distribution of metastases is predictable, with the liver and peritoneum dominating (3,16). The liver is the most common metastatic site at both presentation and disease relapse (3). Metastases to bone and the lung have been previously described, but they are distinctly uncommon, as was the case in our patients (3,19).

The incidence of lymph node metastases is more controversial. We found two cases of enlarged lymph nodes according to CT criteria. A number of other investigators (13,32) have not reported metastatic disease to the lymph nodes. However, pathologic reports indicate lymph node metastases can occur but with insufficient frequency to warrant routine lymphadenectomy (3).

Some authors believed that the tumor behaviors were more malignant behavior in the small intestinal tumor than that of the gastric tumor (14,19). However, in our series, no significant correlation existed between lesion location and malignancy. This may be due to the small sample size in our series.

The liver is the most common metastatic site then the omentum in our series and that concurs with many reports (33–35).

Some of the peritoneal deposits in our series may have been mesenteric nodal metastases. There is agreement that complete surgical excision of the primary tumor offers the best chance of cure (3,13,21). In the absence of metastatic disease, complete resection is usually achievable, since the tumor is typically limited by the serosa of the organ, and when invasive, does so with a pushing rather than infiltrative border, allowing en bloc resection with clear margins (18,20).

The diagnosis of malignant GIST can be suggested on CT scans with the presence of a large well-circumscribed tumor arising from the stomach or small bowel that is usually predominantly extraluminal and has a heterogeneously enhancing soft-tissue rim surrounding a necrotic center. Metastases, if present, will be to the liver or peritoneum. Lymph node enlargement is not a feature.

In conclusion, despite overlap of the radiologic appearances of GISTs and other sarcomatous tumors, the authors believe that if the above imaging features and/or tumor behaviors are recognized, there should be a high level of suspicion for GIST.

References


