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Role of Multislice Computed Tomography Imaging in Gastrointestinal Stromal Tumors.

KEYWORDS: GIST, extraluminal, necrosis

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ABSTRACT *Aim of study:The purpose of this study was to assess the multislice computed tomography (MSCT) imaging features of the gastrointestinal stromal tumors.*

Material and methods:MSCT images of total 37 patients (38 lesions) of gastrointestinal stromal tumors (GISTs) were retrospectively analyzed during the period of October 2011 to December 2015. The images were evaluated for site of tumor origin, size, margins, growth pattern, attenuation and enhancement pattern and presence of necrosis in the lesion, perilesional fat infiltration, relation with adjacent structures, lymphadenopathy and metastases.

Results:Thirty seven patients between the ages of 37 to 70 years diagnosed with GIST were studied which included 21 (56.8 %) men and 16 (43.2 %) women. One patient had two lesions involving stomach and duodenum respectively. Out of the 38 lesions, the tumor was located in stomach in 18 (47.3 %), duodenum in 5 (13.1 %), small bowel in 8 (21 %), large bowel in 2 (5.3 %), and omentum and mesentery in 5 (13.1 %) cases. The size of lesion ranged from 4 to 30 cm with mean size of 10.9 cm. The margins of the tumor were well defined regular in 22 (57.9 %) lesions, well defined lobulated in 13 (34.2 %) and ill-defined irregular in 3 (7.9 %) lesions. Out of 38 lesions, 26 (68.4 %) showed extraluminal growth pattern while 12 (31.6 %) tumors had extra as well as intraluminal growth. The tumors had CT attenuation in the range of 10 to 55 HU with mean attenuation value of 37.5 HU. Homogeneous enhancement pattern was seen in 8 (21%) tumors while 30 (79%) lesions showed heterogeneous enhancement. The perilesional fat infiltration was present in 14 (36.8%) tumors and loss of fat planes with adjacent structures was seen in 12 (31.6 %) lesions. Four patients (10.8 %) had associated lymphadenopathy while metastases were present in 6 (16.2%) cases. Two (5.2 %) patients had intestinal obstruction at the time of presentation and ascites was seen in 14 (37.8%) patients.

Conclusion: The diagnosis of GISTs on CT imaging could be made reliably in presence of large well-defined predominantly exophytic tumor with heterogeneous enhancement and cystic necrosis. MSCT imaging plays an important role in detection, characterization and staging of GISTs.

Introduction

The term gastrointestinal stromal tumor (GIST) was first coined by Mazur and Clark in 1983 (1) to describe an unusual type of gastrointestinal tract (GIT) tumor without the typical features of smooth muscle or Schwann cells. Currently GIST are considered to be heterogeneous group of nonepithelial smooth muscle neoplasm of the GIT arising from the precursor of interstitial cells of Cajal which are present in the myenteric plexus and are separate from other mesenchymal tumors, such as leiomyomas or leiomyosarcomas (2). The GIST can originate from any portion of the GIT and also in the mesentery or omentum (3, 4, 5). The clinical manifestations of GISTs depend on the location and size of the tumors and are often nonspecific. Multislice computed tomography (MSCT) imaging plays an important role in detection and characterization of these tumors (6-11). The purpose of this study was to evaluate the specific MSCT imaging features of the gastrointestinal stromal tumors.

Material and Methods

Total 37 patients (21 men and 16 women), who were diagnosed with gastrointestinal stromal tumors and had undergone CT examination at Smt. Kashibai Navale Medical college and GH, Pune from October 2011 to December 2015, were identified for this retrospective study. CT scans were performed on Siemens Somatom Spirit multidetector helical CT. Oral and rectal contrast was administered in all patients to opacify the bowel. Contiguous axial CT sections were obtained before injection of contrast and in arterial, venous and delayed phases after the injection of iodinated contrast. Axial source images and multiplanar reformatted images were viewed and analyzed in detail. The final definitive diagnosis was obtained by histological examination of surgical or biopsy specimen. The institutional ethical committee cleared the study. The images were evaluated for site of tumor origin, size, margins, growth pattern, attenuation and enhancement pattern and presence of necrosis in the lesion, perilesional fat infiltration, relation with adjacent structures, and presence of lymphadenopathy, metastases and other associated findings such as intestinal obstruction or dilatation and ascites

Results

Thirty seven patients diagnosed with GIST were included in the present study (Table. 1) with 21 (56.8 %) men and 16 (43.2 %) women (M: F ratio of 1.3:1). The mean age of the patients was 55.5 years (54.7 years for men and 56.3 years for women) with an age range of 37 to 70 years. The maximum number of patients was in the age range of 51 to 60 years (15 patients, 40.5 %), followed by 61 to 70 years (12 patients, 32.4%). The most common clinical complaint was pain in abdomen (24 patients, 64.9%), followed by anemia (15 patients, 40.5%). Twelve patients (32.4 %) presented with abdominal lump and 9 patients (24.3 %) complained of bleeding or malena. Ten patients (27 %) had abdominal distension and 9 patients (24.3 %) complained of vomiting. Total 38 lesions were evaluated

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in 37 patients as one patient had two lesions involving stomach and duodenum respectively (Fig.1A-C). Table 2 demonstrates the spectrum of CT imaging findings that were present in these patients. Out of the 38 lesions, the tumor was located in stomach in 18 (47.3 %), duodenum in 5 (13.1 %), small bowel in 8 (21 %), large bowel in 2 (5.3 %), and omentum and mesentery in 5 (13.1 %) cases (Fig.2 A-F). Out of eighteen lesions originating from stomach, 9 lesions were located in fundus, 5 in pylorus and 2 each were seen involving the lesser and greater curvature respectively. The large bowel lesions were seen in hepatic flexure and transverse colon. The size of lesion ranged from 4 to 30 cm with mean size of 10.9 cm. The margins of the tumor were well defined regular in 22 (57.9 %), well defined lobulated in 13 (34.2 %) and ill-defined irregular in 3 (7.9 %) lesions. Out of 38 lesions, 26 (68.4 %) showed extraluminal growth pattern while 12 (31.6 %) tumors had extra as well as intraluminal growth with bowel wall thickening at the site of tumor origin seen in 20 (52.6%) cases. Mucosal ulcerations at the site of tumor origin were seen in 9 (23.7%) lesions, while tumor cavitations with air-fluid/contrast levels were seen in 3 patients (7.9%) out of which two were gastric GISTs and one lesion was in duodenum (Fig.1B). The tumors had CT attenuation in the range of 10 to 55 HU with mean attenuation value of 37.5 HU. Post contrast homogeneous enhancement pattern was seen in 8 (21%) tumors while 30 (79%) lesions showed heterogeneous enhancement. The degree of enhancement was mild, moderate and strong in 7 (18.4%), 25 (65.8%) and 6 (15.8%) lesions respectively. Low attenuation nonenhancing necrotic or cystic areas were seen in 30 (78.9%) lesions, out of which 11 (28.9%) had small necrotic areas, 15 (31.6 %) had large necrotic/cystic areas (Fig.1B, Fig.2D & E, Fig.3A) and 4 (10.5%) lesions were predominantly cystic in nature (Fig.2D, Fig. 3E & F). One patient with large abdominopelvic predominant cystic mass, initially thought to be an ovarian neoplasm, was proved to have large exophytic GIST arising from stomach (Fig. 3E & F). The perilesional fat infiltration was present in 14 (36.8%) tumors while loss of fat planes with adjacent structures was seen in 12 (31.6 %) patients. Four patients (10.8 %) had associated lymphadenopathy while metastases were present in 6 (16.2%) cases out of which 2 (5.4 %) had liver metastases (Fig.3A & B) and 4(10.8 %) had omental metastases (Fig. 3C). No lung or bone metastases were identified in present study. Two (5.2 %) patients had intestinal obstruction at the time of presentation and ascites was seen in 14 (37.8%) patients ((Fig.3A). Other findings included pleural effusion (4 lesions, 10.8%), calcification (2 lesions, 5.4 %) and intralesional vessels (2 lesions, 5.4 %) (Fig.3D). The final definitive diagnosis was obtained by histological examination of surgical or biopsy specimen.

Discussion

Gastrointestinal stromal tumors (GISTs), accounting for less than 1% of all gastrointestinal tumors, are most common mesenchymal neoplasms of the GIT (12). These tumors were previously classified as leiomyomas, leiomyoblastomas or leiomyosarcomas due to presence of smooth muscles features on routine microscopy. However, with the advent of electron microscopy and immunohistochemistry, lack of immunophenotypic features of smooth muscle cells or Schwann cells was noted in these lesions (1, 8). Mazur and Clark in 1983 (1) first used the term "stromal tumors" as a separate entity to describe these unusual type of GIT tumors. GISTs are now considered as heterogeneous group of nonepithelial smooth muscle neoplasm of the GIT arising from the precursor of interstitial cells of Cajal which are present in the myenteric plexus (2). About 95% of GISTs show positive staining for CD117 (c-KIT) antigen. It is an epitope of the KIT, a tyrosine kinase growth factor receptor and helps to distinguish GISTs from other mesenchymal neoplasms such as leiomyomas, leiomyosarcomas, schwannomas, and neurofibromas (2,3,13). Computed tomography (CT) is the imaging modality of choice for diagnosis and staging of GISTs at initial presentation and for monitoring the disease during and after treatment (6-11).

Most patients of GISTs are over the age of 50 years at the time of presentation with median age ranging from 50-60 years (3, 7). The mean age of the patients was 55.5 years in our study with an age range of 37 to 70 years. Out of 37 patients in the present study, 21 (56.8 %) were men and 16 (43.2 %) were women with slight male predominance (M: F ratio of 1.3:1). GISTs show no significant gender predilection, though slight male predominance has been reported in some studies (7, 15-17). The clinical presentations of patients with GIST depend on the anatomic location, size and aggressiveness of the tumor (7, 18). The most common clinical manifestation is gastrointestinal bleeding from mucosal ulcerations and can also result in anemia in chronic cases (7, 19). Other clinical manifestations include nausea, vomiting, abdominal pain, weight loss and abdominal distention. Patients may also have acute presentations caused by tumor rupture and intestinal obstruction. Small asymptomatic lesions may be incidentally detected during radiologic studies, surgical procedure or endoscopy (7). The most common clinical presentation in our study was pain in abdomen (64.9%), followed by anemia (40.5%), abdominal lump (32.4 %), abdominal distension (27 %) and acute GI bleeding (24.3 %). Two patients (5.2 %) patients had intestinal obstruction at the time of presentation.

GISTs can occur anywhere along the GIT, but are more commonly seen stomach (37-70%), small bowel (20-33%), followed by duodenum (9%), anorectum (5-7%), colon (4%) and esophagus (<2%) (3, 20, 21). GISTs can also occur in omentum, mesentery and retroperitoneum (7, 22, 23). Out of the 38 lesions in present study, the tumor was located in stomach in 18 (47.3 %), duodenum in 5 (13.1 %), small bowel in 8 (21 %), large bowel in 2 (5.3 %), and omentum and mesentery in 5 (13.1 %) cases. One patient had two tumors arising from separate locations, one lesion originating from stomach and second lesion located in duodenum (Fig.1). Gasparotto D, Rossi S et al (24) in their study noted that a significant fraction of adult sporadic GIST patients with multifocal manifestations are actually affected by multiple primary GISTs. Most of the GISTs arise from the muscularis propria leading to predominant exophytic rather than intraluminal or intramural growth pattern (4,7,25). Part of exophytic tumor often extends upto the mucosal surface at the site of origin and shows mucosal ulcerations (6, 25). Out of 38 lesions in present study, 26 (68.4 %) showed extraluminal growth pattern while 12 (31.6 %) tumors had extra and intraluminal growth with mucosal ulcerations at the site of tumor origin seen in 9 (23.7%) lesions. The tumor size ranges from several millimeters to greater than 30 cm (7, 25). Because most of the GISTs are exophytic, they usually attain large size without causing bowel obstruction at the time of diagnosis. The size of lesions ranged from 4 to 30 cm in our study and mean size was 10.9 cm.

The GISTs are typically seen as large exophytic tumor arising from GIT with heterogeneous contrast enhancement on CT imaging. However, the enhancement pattern can vary from homogenously enhancing, usually in smaller well

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defined tumors (6) to heterogeneous enhancement in large masses with areas of necrosis or cystic degeneration (7). Large exophytic lesions with extensive hemorrhage or necrosis lead to formation of large cystic spaces or cavities. In our study, homogeneous enhancement pattern was seen in 8 (21%) tumors while 30 (79%) lesions showed heterogeneous enhancement. Low attenuation nonenhancing necrotic or cystic areas were seen in 30 (78.9%) lesions, out of which 11 (28.9%) had small necrotic areas, 15 (31.6 %) had large necrotic/cystic areas and 4 (10.5%) lesions were predominant cystic in nature (Fig. 2 & 3). Tumor cavitations communicating with intestinal lumen and air-fluid levels were seen in 3 patients (7.9%) out of which two were gastric GISTs and one lesion was in duodenum (Fig. 1B). Calcification is uncommon in GISTs (7) and was seen in 2 lesions (5.4 %). Majority of the GISTs in our study had well defined margins, well defined regular in 22 (57.9 %) and well defined lobulated in 13 (34.2 %) lesions. These findings correlates with study by Lee et al (6), who reported well defined tumor margins in more than two-thirds of the GISTs. GISTs usually displace the adjacent organs and vessels, while direct invasion of the adjacent structures is mostly seen with advanced disease and is well demonstrated on CT (6, 7). The loss of fat planes between the lesion and adjacent structures was seen in 12 (31.6 %) patients in present study. In our study, ascites was seen in 14 (37.8%) patients and four patients (10.8 %) had lymphadenopathy. Metastases were present in 6 (16.2%) cases out of which 2 (5.4 %) had liver metastases and 4(10.8 %) had omental metastases. Most metastases of GISTs involve the liver and peritoneum by haematogenous spread and peritoneal seeding, respectively and less commonly metastases are found in the soft tissue, lungs, and pleura (22). Pinaikul S et al (26) reported presence of adjacent organ invasion, ascites, lymphadenopathy, liver metastasis, and peritoneal seeding as CT signs of malignancy in patients of GISTs.

The differential diagnosis of GIST depending on the location includes adenocarcinoma, lymphoma, peritoneal carcinomatosis, carcinoid and metastases and other mesenchymal neoplasm like leiomyoma (7, 22). Adenocarcinoma is seen as an irregular mucosal or polypoidal growth commonly associated with lymphadenopathy, metastases and ascites. Lymphoma, more common in stomach and small bowel presents as circumferential wall thickening or aneurysmal dilatation of bowel loops with abdominal lymphadenopathy. Multiple soft tissue lesions with omental caking, ascites, and lymphadenopathy are seen in peritoneal carcinomatosis. Carcinoids are well-defied, homogenously enhancing bowel masses with desmoplastic reaction. Imatinib is a molecularly targeted tyrosine kinase receptor blocker chemotherapeutic agent used in the treatment of GIST (22, 27). Patients of GISTs show good response to Imatinib with improved long-term survival after surgical tumor resection.

Conclusion: To conclude, the stomach was the commonest site of GIST in our study. The diagnosis of GISTs on CT imaging could be made reliably in presence of large well-defined predominantly exophytic tumor with heterogeneous enhancement and cystic necrosis. MSCT imaging plays an important role in detection, characterization and staging of GISTs.

Table 1: Age and Sex-wise distribution of patients

Age in years /Sex	Male	Female	Total
31-40	2	2	4
41-50	4	2	6
51-60	9	6	15
61-70	6	6	12
Total	21	16	37

Table 2: Spectrum of MSCT imaging findings in GISTs.

Sr. No.	Imaging findings	Details with number of lesions / percentage (n= 38)
1.	Location	Stomach – 18 (47.3 %) Duodenum – 05 (13.1 %) Small bowel – 08 (21 %) Large bowel – 02 (5.3 %) Omentum & mesentery – 05 (13.1 %)
2.	Lesion size	Size range – 4 to 30 cms Mean size – 10.9 cms
3.	Margins	Well defined regular – 22 (57.9 %) Well defined lobulated – 13 (34.2 %) Ill-defined irregular – 03 (7.9 %)
4.	Growth pattern – Intraluminal/ Extraluminal	Extraluminal – 26 (68.4 %) Extra & intraluminal – 12 (31.6 %)
5.	Wall thickening at the site of origin.	20 (52.6%)
6.	CT attenuation	Attenuation range – 10 to 55 HU Mean attenuation – 37.5 HU
7.	Enhancement pattern – Homogeneous/ Heterogeneous	Homogeneous – 08 (21%) Heterogeneous – 30 (79%)
8.	Enhancement degree Mild/moderate/ strong	Mild – 07 (18.4%) Moderate – 25 (65.8%) Strong – 06 (15.8%)
9.	Cystic necrotic component	30 (78.9%) Small cystic areas– 11 (28.9%) Large cystic areas – 15 (31.6 %), Predominant cystic lesion – 04 (10.5%)
10.	Mucosal ulcerations at the site of origin	09 (23.7%)
11.	Perilesional fat infiltration	14 (36.8%)
12.	Relation with adjacent structures or organs	Fat planes lost – 12 (31.6 %) Fat planes preserved – 26 (68.4%)
13.	Lymphadenopathy	04 (10.8 %)
14.	Metastases	06 (16.2 %) Liver – 02 (5.4 %) Omentum – 04(10.8 %)
15.	Intestinal obstruction/ dilatation	02 (5.4 %)
16.	Ascites	14 (37.8%)
17.	Any other findings	Pleural effusion – 04(10.8%) Calcification – 02 (5.4%) Intralesional vessels – 02(5.4%)

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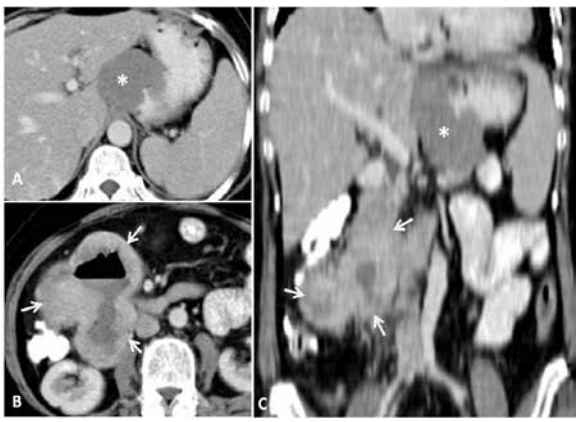

Figure 1: CECT axial (A, B) sections and coronal reformatted (C) image in patient with double GISTs showing two separate tumors arising from stomach (*) and duodenum (white arrows). The duodenal lesion shows central necrosis and cavitation with air-fluid level (B).

Figure 2: Contrast enhanced CT (CECT) images showing well defined heterogeneously enhancing soft tissue attenuation lesions arising from pylorus (A) and from small bowel (B & C, long white arrows). CECT image in another patient showing well defined heterogeneously enhancing mass with large cystic necrotic area (D). CECT images show GISTs originating in omentum (E) and hepatic flexure (F, short white arrows).

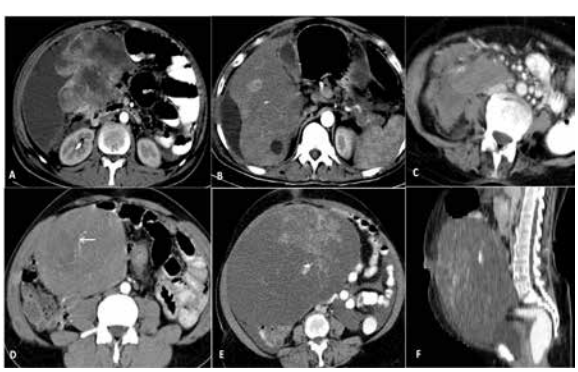

Figure 3: CECT axial images showing exophytic lobulated heterogeneously enhancing soft tissue lesion (A) with ascites and liver metastases (B). CECT axial image in another patient of duodenal GIST showing omental deposits (C). MSCT axial scan shows mesenteric GIST with internal vessel (D, white arrow). Axial (E) and coronal reformatted (F) CECT images show large heterogeneous predominantly cystic mass which was proved to be gastric GIST.

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