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THE ROLE OF COMPUTED TOMOGRAPHY IN THE EVALUATION OF GASTROINTESTINAL STROMAL TUMORS

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Abstract

Gastrointestinal stromal tumors (GISTs) are the most common mesenchymal neoplasms of the digestive tract and Computed tomography (CT) is an imaging modality of choice for the detection and evaluation of GISTs.

This study aimed to describe the computed-tomographic imaging features of gastrointestinal stromal tumors in our clinical work and to evaluate and improve our CT protocols in the diagnosis of GIST.

This is a cross-sectional study conducted in the period of October 2011–December 2012 in the Radiology Institute and the GIT Center of Medical City in Baghdad. Twenty cases of GIST were analyzed by multidetector abdominal CT including fifteen male and five female patients of age (20-70) years. Images were analyzed for tumor location, size, definition, diameter, shape and other features.

The results showed that 13 (59%) of tumors were located in the stomach and five (23%) were located in the mesentery. GISTs were extraluminal in 13 (59%) patients. The tumor margins of 13 (59%) tumors were well defined, and irregular in eight (36%). Location of GISTs did not correlate with their definition, diameter or shape; while a significant correlation had been found with the hemorrhage and enhancement.

In conclusion, CT scan is the most common imaging technique for the detection, localization and initial evaluation of GIST extension. The stomach was the commonest location of GIST occurrence among our patients. The CT features of GISTs were well-defined tumor margins, extraluminal site and fungating morphology.

Introduction

The term gastrointestinal stromal tumor has traditionally been used as a descriptive term for soft tissue tumors of the gastrointestinal tract. GISTs were previously thought to be smooth muscle neoplasms, and most were classified as leiomyomas or leiomyosarcomas but growing evidence over the last two decades suggests that GISTs are a unique entity and separate from leiomyomas and leiomyosarcomas. GISTs are now defined as spindle cell, epithelioid, and occasionally pleomorphic mesenchymal tumors of the gastrointestinal tract that express the KIT protein (CD117, stem cell factor receptor) detected at immuno-histochemistry. This feature differentiates GISTs from leiomyomas, leiomyo-sarcomas, schwannomas, and neurofibromas, which do not express the KIT protein[1]. Gastrointestinal stromal tumors are rare, accounting for less than 3% of all gastrointestinal neoplasm and less than 6% of all sarcomas[2]. GISTs are thought to arise from interstitial cells of Cajal (ICC) that are normally part of the autonomic nervous system of the intestine. They serve a pacemaker function in controlling motility[3]. Computed tomography (CT) is considered to be the imaging modality of choice for the detection, staging, surgical planning and follow-up of patients with GISTs. CT is commonly used to assess therapeutic

response in patients with GISTs. The majority of GISTs appear to be well-defined, extra-luminal or intramural masses with varying attenuation on CT based on size[4].

The main purposes of this study to describe the computed-tomographic imaging features of gastrointestinal stromal tumors (GISTs) in our clinical work and to evaluate and improve our CT protocols in the diagnosis of GIST.

Patients and methods

This is a cross-sectional study done in the period of October 2011–December 2012. Twenty cases of GIST were analyzed by multidetector abdominal CT including fifteen male and five female patients of age (20-70) years. The cases were referred from gastrointestinal tract surgeons and clinicians. The CT examinations were done in the Radiology Institute and the GIT Center of Medical City in Baghdad. The CT findings were analyzed by the researcher and supervised by a consultant radiologist. The definite diagnosis was established by surgery and histopathology in all cases. The undiagnosed cases were excluded from this study. CT examinations were performed in all patients using 64 slice multidetector CT system (Toshiba Aquilion 64 and Philips Briliance 64).

All patients were examined in supine position in craniocaudal direction, the CT protocol included KVp 120, MA 250, slice thickness 1 and 5 mm in GIT Center and 5 mm in Radiology Institute. The preparation for suspected gastric lesion was fasting in the morning only, for suspected small bowel lesions was light dinner and fasting till examination time next morning, and for suspected large bowel lesion no dinner and castor oil at night and in the morning of the day of examination.

Image acquisition included native study first, followed by a contrast-enhanced study involving oral and I.V. contrast at the same acquisition. Oral contrast for gastric lesion was one liter of water only. For small bowel lesions 1500-2000 ml of water containing 30-40 ml of contrast in divided doses of 500ml /30 min. For large bowel lesions, we used 2000-3000 ml of water containing 40-50 ml of contrast also in divided doses. For I.V. contrast, a dose of 1.5ml/kg of Iohexol 350 mgI/ml was used. Imaging was done after 15 minutes for stomach, 2 hours for small bowel, 3 hours for proximal large bowel and 5 hours for distal large bowel after starting the intake of oral contrast. Imaging was done after 50-60 seconds after I.V. contrast administration.

Results

There were 20 patients enrolled in this study, two patients of them had two GISTs in two different locations [total=22 GISTs].

Age distribution: The mean age of patients was (44±11) years, the age group of 41-50 years was significantly the more prevalent age group among patients; 12 (60%) of all patients ($P<0.05$).

Sex distribution: Male gender significantly more prevalent among patients; males were 15 (75%), male to female ratio was 3:1 ($p<0.05$).

Clinical features: Abdominal pain and nausea were, relatively more prevalent clinical features, 6 (30%) for each, other clinical features such as vomiting, hematemesis, loss of appetite, melena, weight loss, dyphagia …etc; statistically, no significant differences identified in frequencies of these clinical features, ($P>0.05$).

Location and site of tumor: Stomach was significantly the more common location of tumor; 13 (59%) of patients compared to 5 patients (23%) with tumors at mesentery , 3 patients (13%) with tumors in the small bowel and only one patient (5%) in the colon, $P<0.05$, table I.

The extraluminal was the more prevalent site among patients; it is the site of tumor in 13 patients (59%) versus 4 (18%) patients with wall site, $P <0.05$, Table (I).

Table I: Distribution of location and site of tumor.

Variable		Number	Percent	P. value
Location	Stomach	13	59%	0.011 sig
	Small bowel	3	13%	
	Colon	1	5%	
	Mesentery	5	23%	
Site	Extraluminal	13	59%	0.042 sig
	Wall	4	18%	
	Mesentery	5	23%	

Table II: Correlation between Location and definition of tumor.

Definition	Location (N=22)				Total	P value
	Stomach	Small bowel	Mesentery	Colon		
well defined	9	2	1	1	13	0.22 ns
	69.2%	66.7%	20.0%	100.0%	59.1%	
Ill defined	3	1	4	0	8	
	23.1%	33.3%	80%	0.0%	36.4%	
Partially well defined	1	0	0	0	1	
	7.7%	0.0%	0%	0.0%	4.5%	
Total	13	3	5	1	22	
	100.0%	100.0%	100%	100.0%	100.0%	

No significant correlation had been found, P>0.05

Table III: Correlation between Location and diameter of tumor.

Diameter (cm)	Location (N=22)				Total	P value
	Stomach	Small bowel	Mesentery	Colon		
≤5	8	1	1	1	11	0.20 Ns
	61.5%	33.3%	20.0%	100.0%	50.0%	
> 5 – 10	3	1	2	0	6	
	23.1%	33.3%	40.0%	0.0%	27.3%	
> 10	2	1	2	0	5	
	15.4%	33.3%	40.0%	0.0%	22.7%	
Total	13	3	5	1	22	
	100.0%	100.0%	100.0%	100.0%	100.0%	

No significant correlation had been found, P>0.05.

Table IV: Correlation between Location and shape of tumor.

Shape	Location (n=22)				Total	P value
	Stomach	Small bowel	Mesentery	Colon		
Fungating	6	3	4	0	13	0.53 Ns
	46.2%	100.0%	80.0%	0.0%	59.1%	
Polypoidal	3	0	0	1	4	
	23.1%	0.0%	0.0%	100.0%	18.2%	
Cystic	2	0	1	0	3	
	15.4%	0.0%	20.0%	0.0%	13.6%	
Ulcerative	2	0	0	0	2	
	15.4%	0.0%	0.0%	0.0%	9.1%	
Total	13	3	5	1	22	
	100.0%	100.0%	100.0%	100.0%	100.0%	

No significant correlation had been found, P>0.05.

Table V: Correlation of location of tumor and density, calcification, Hemorrhage, necrotic changes and enhancement.

Variables		Location (n=22)				P. value
		Stomach	Small bowel	Mesentery	Colon	
Density	Homogeneous	7	0	1	1	0.29 ns
		53.8%	.0%	20.0%	100.0%	
	Heterogeneous	6	3	4	0	
		46.2%	100.0%	80.0%	.0%	
Calcification	Positive	1	0	1	0	0.8 ns
		7.7%	.0%	20.0%	.0%	
	Negative	12	3	4	1	
		92.3%	100.0%	80.0%	100.0%	
Haemorrhage	Positive	1	1	4	0	0.018 sig
		7.7%	33.3%	80.0%	.0%	
	Negative	12	2	1	1	
		92.3%	66.7%	20.0%	100.0%	
Necrotic Changes	Positive	5	2	4	0	0.49 ns
		38.5%	66.7%	80.0%	.0%	
	Negative	8	1	1	1	
		61.5%	33.3%	20.0%	100.0%	
Enhancement	Positive	13	2	5	1	0.041 sig
		100.0%	66.7%	100.0%	100.0%	
	Negative	0	1	0	0	
		.0%	33.3%	.0%	.0%	
Enhancement degree	Mild	7	1	1	1	0.38 ns
		53.8%	33.3%	20.0%	100.0%	
	Non-homogenous	6	2	4	0	
		46.2%	66.7%	80.0%	.0%	

No significant correlation had been found between location of tumor and density, calcification, necrotic changes, or enhancement degree, in all comparison P> 0.05, while A significant correlation had been found with the Hemorrhage and enhancement, P<0.05. Correlation of size of tumor and metastasis: Metastasis was present in 3 (15%) of cases (all with liver metastasis). It had been significantly found that metastasis was directly correlated with the size of tumor, none of patients with size of ≤5 cm had metastasis compared to 3 patients more than 5 cm size, P<0.05.

Table VI: Correlation between size of tumor and metastasis

Size	Metastasis		Total
	Yes	No	
≤5	0	10	10
	.0%	100.0%	100.0%
> 5 – 10	1	6	7
	14.3%	85.7%	100.0%
> 10	2	1	3
	66.7%	33.3%	100.0%
Total	3	17	20
	15.0%	85.0%	100.0%
P = 0.019 sig			

Correlation of location of tumor and metastasis: no significant correlation had been found between location of GISTs and metastasis, (P>0.05). Among the twenty cases of GIST proved by histopathology, thirteen cases were suggested as GIST by CT. For the other seven cases, the CT was not conclusive as GIST before surgery.

Table VII: Most common findings and characteristics among patients (total patients number =20)

Finding	Number	Percent
Age group 41 - 50 years	12	60%
Male gender	15	75%
Positive medical history	2	10%
Surgical history	4	20%
Nausea and abdominal pain	6	30%
Stomach involvement	13	65%
Extraluminal site	9	45%
well defined	13	65%
≤ 5 diameter	11	55%
fungating shape	13	65%
Heterogeneous density	13	65%
Calcification	2	10%
Haemorrhage	6	30%
Necrotic Changes	11	55%
Enhancement	20	100%
Non-homogenous Enhancement	12	60%
LAP	2	10%
Metastasis	3	15%
Obstruction	1	5%

Discussion

GISTs occur equally in both sexes and have a unimodal peak incidence in persons aged 40-70 years[8]. In our study, patients with GIST were similar to the literature findings concerning age and peak of incidence[2]. Sex distribution in this study showed a male predominance, which differs from other studies[2,5]. This could be attributed to the small sample size of this study.

The clinical manifestations of GISTs depend on the location and size of tumors and are often nonspecific. The most frequent symptoms in our study were abdominal pain and nausea (30%), followed by loss of appetite and vomiting (20%). This presentation agrees with previous studies[2].

There are similarities between the CT protocol adopted in this study and the ones used by Lupescu et al and Lee et al[2,6]. However; we used smaller slice thickness (1 and 5 mm). Lupescu et al used a slice thickness of 5-7 mm and Lee et al. used a slice thickness of 10 mm.2,6 We specified time intervals between intake of oral contrast and image acquisition for different parts of gastrointestinal tract. Such details were not described by either Lupescu or Lee[2,6].

Regarding location, 59% of GISTs in our study were located in the stomach, 23% in the mesentery and 5% in the colon.

This is similar to the findings in previous studies[2,6]. The percentages of GISTs arising from the small bowel and esophagus (13% and 0%) were less than percentages reported by Hersh and Lupescu[1,2]. This might be explained by the small sample size and the possibility of location misclassification, especially with large tumors. Most of GISTs included in this study were extraluminal (59%, n=13), while only 18% (n=4) were intramural/endoluminal. This concurs with findings reported by Lee et Al[6].

In our study, most of the tumors were well-defined (59.1%, in agreement with Lee et. al[6], and fungating in morphology (59.1%). Half of the GISTs in this study have a diameter of less than 5 cm. No significant correlation was found between the location of tumor and the definition, diameter, or shape of the tumor. Density of the tumor, calcification, necrotic changes, and enhancement degree did not exhibit significant correlation with the location of GISTs. Only hemorrhage and enhancement showed a significant correlation with location, where 80% of GISTs in the mesentery (n=4) exhibited hemorrhage, and nearly all GISTs showed enhancement (95.4%, n=21), apart from 33.3% of those located in the small bowel (n=1). No significant correlation was found between GISTs presenting with bowel obstruction and either of lymphadenopathy or metastasis.

Metastasis was present in 3 (15%) of cases (all with liver metastasis). The incidence of metastasis (liver and peritoneum) at presentation in the largest clinical series of malignant GISTs approached 50%[7,8]. Liver is the most common metastatic site at both presentation and disease relapse[2]. Metastasis at bone and the lung have been previously described, but they are distinctly uncommon[2].

The incidence of lymph node metastasis was reported as very rare in previous studies[8,9,10]. This helps in differentiation of GISTs from lymphoma or leiomyosarcoma. In our study, only 10% of patients had lymphadenopathy.

For our patients, it had been significantly found that metastasis was directly correlated with the size of tumor. None of our patients with a tumor size of less than or equal to 5 cm had metastasis, while the 3 patients with metastasis had tumors of more than 5 cm in size. However, metastasis did not correlate with the location of the tumor. Among the twenty-two tumors proved to be GIST by histopathology, fifteen tumors were suggested as GIST by CT. For the other seven tumors, CT appearance was not conclusive as GIST before surgery.

An abdominal CT scan must be done before surgery in order to exclude liver or peritoneal metastasis and to evaluate the extension of the primary tumor. As most GISTs have an exophytic growth, CT is more useful than endoscopy and barium studies to evaluate the real size of the tumor and its extension[11,12].

The imaging diagnosis of malignant GIST can be suggested in the presence of a large, complex, gastric or intestinal mass with liver lesions but without significant lymphadenopathy[13], but the gold standard remains the histological diagnosis, however, transabdominal biopsy is not recommended in potentially resectable cases because of the risk of tumor seeding[13].

Differential diagnosis is made with leiomyoma, which are benign mesenchymal tumors, most commonly located in the esophagus, sharply defined spherical masses with homogeneous or discrete heterogeneous enhancement. Focal calcifications may be present[13].

The differentiation from other primary GI malignancies can be made on the basis of specific findings. Lymphoma diagnosis can be suggested in the presence of a circumferential mural thickening with homogeneous enhancement and/or lymph node enlargement[1,13]. Carcinoid tumors are found in the terminal ileum or root of the mesentery and commonly stimulate a desmoplastic reaction with calcifications[1,14]. Carcinomas produce local infiltration and visceral obstruction, especially in large tumors. Metastases are multifocal masses, in a context of primary known malignancy.

There are several limitations in our study. It included a small number of patients because of the relatively limited time and resources available for the study. This small sample size affected the analysis and results obtained in this study. In addition, we did not follow-up the patients regarding long-term post-surgical outcome, to identify the CT features of GISTs which may develop recurrence. Referral bias is a potential limitation in our study since some cases were received at the GIT Center which is a tertiary center. The referred patients and their GISTs may have different characteristics from other patients and tumors that were diagnosed in less-specialized centers without the need for referral.

Conclusion

CT results usually suggest the diagnosis of GIST and help determine the next diagnostic steps, thus avoiding transabdominal biopsy associated with a risk of peritoneal seeding. As most GISTs have an exophytic growth, CT is more useful than endoscopy and barium studies to evaluate the real size of the tumor and its extension. The stomach was the commonest location of GIST occurrence among our patients. The CT features of GISTs were well-defined tumor margins, extraluminal site and fungating morphology.

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