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The Role of MSCT in Evaluating Tumor Size, Density, Immunohistochemical Classification, and Pathological Risk in GIST Patients

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Abstract: *Objective:* To investigate the role of multilayer spiral CT (MSCT) in evaluating patients with gastrointestinal stromal tumors (GIST), particularly its utility in determining tumor size, immunohistochemical classification, and pathological risk. *Methods:* A retrospective analysis was conducted on 22 GIST patients, confirmed by surgical pathology between January 2019 and December 2023. All patients underwent MSCT examination prior to surgery. Tumor size, density, and immunohistochemical classification from the MSCT results were compared with the postoperative pathological findings. Additionally, the ability of MSCT to predict GIST risk grade was evaluated in combination with immunohistochemical analysis results. *Results:* No significant differences were found between the preoperative MSCT findings and postoperative pathological results in terms of tumor size, density, or immunohistochemical classification in GIST patients. MSCT also enhanced the ability to predict GIST risk grades. *Conclusion:* MSCT demonstrates significant clinical value in the diagnosis and risk assessment of GIST, aiding in the prediction of the tumor's biological behavior and patients' treatment responses.

Keywords: Gastrointestinal stromal tumor; Multilayer spiral CT; Tumor size; Immunohistochemistry; Pathological risk

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1. Introduction

Gastrointestinal stromal tumor (GIST) is the most common tumor of gastrointestinal stromal origin [1]. Unlike adenomas and carcinomas, which originate from the epithelial cells of the digestive tract, GIST typically presents with no specific symptoms or only mild gastrointestinal discomfort. However, some patients may experience symptoms such as gastrointestinal bleeding or obstruction. With advances in imaging technology, particularly the application of multilayer spiral CT (MSCT), the diagnostic accuracy of GIST has significantly improved. Early and accurate diagnosis is essential for effective treatment planning and prognosis assessment. The purpose of this study is to evaluate the value of MSCT in determining GIST tumor size, density, immunohistochemical classification, and pathological risk.

2. Materials and methods

2.1. Study subjects

Twenty-two patients with GIST, confirmed by surgical pathology in Zhanjiang Central People's Hospital between 2019 and 2023, were selected for retrospective analysis. All patients underwent an MSCT scan before surgery. The detailed image analysis provided by MSCT showed that it could not only accurately measure tumor size and density but also offer important information to determine the malignant potential of the tumors [1].

2.2. MSCT scan

A Toshiba 64-row spiral CT machine was used for scanning. Scanning parameters included a 5 mm layer thickness, no spacing, 120 kV, and automatic mAs regulation, with image reconstruction using a soft tissue algorithm. Enhanced scans were performed using nonionic contrast agents, with a total volume of 1.5 mL/kg body weight and a flow rate of 3.0 mL/s.

2.3. Image analysis

Image analysis was independently conducted by two radiologists, each with more than ten years of experience. The analysis included tumor location, maximum diameter, morphology, boundaries, density, and enhancement features. Tumor location was categorized as stomach, jejunum, ileum, or abdominal cavity. Tumor morphology was classified as irregular, mass, nodule, round, or cystic. Size was based on the long axis, and boundaries were noted as either clear or unclear. Growth patterns were categorized as luminal, extraluminal, or mixed. Tumor enhancement was classified as mild (< 20 HU), moderate (20–40 HU), or severe (> 40 HU) [1].

2.4. Immunohistochemistry and pathological risk assessment

Immunohistochemical staining for CD117 and DOG-1 was performed on postoperative pathological specimens, and evaluated according to Fletcher's risk classification criteria [2].

2.5. Observation indicators

A retrospective analysis of tumor location, diameter, morphology, boundaries, density, and enhancement characteristics was conducted using MSCT imaging, and these findings were compared with pathological results obtained after surgery. The study also compared tumor size, density, and immunohistochemical classification, assessing the predictive ability of MSCT for GIST risk classification.

3. Results

Among the 22 patients with GIST, 3 tumors originated in the stomach (**Figure 1 left**), 14 in the small intestine (including the jejunum and ileum) (**Figure 1 middle**), and 5 in the abdominal cavity (including 1 patient with a recurrent intraperitoneal tumor, as shown in **Figure 1 right**).

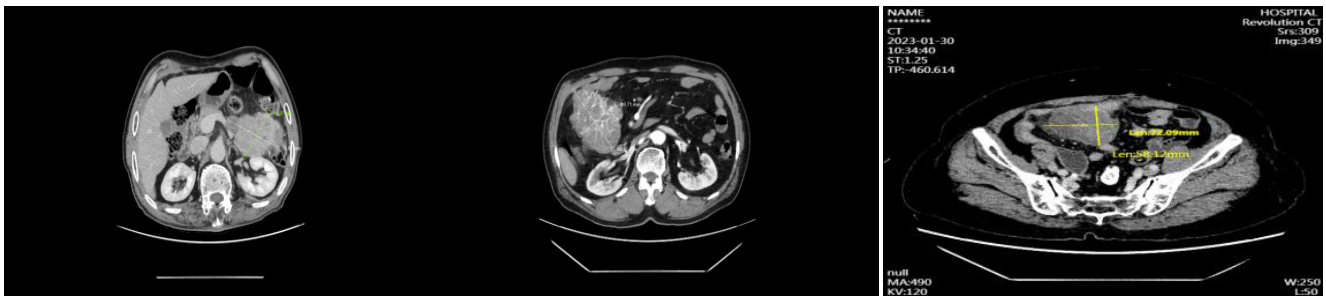

Figure 1. MSCT scans of 22 patients with GIST showed the stomach **(left)**, small intestine **(middle)**, and abdominal cavity **(right)**.

Table 1 shows the tumor size of the 22 patients, as measured by MSCT and described pathologically.

Table 1. Comparison of tumor size

No.	Mass size (MSCT)	Mass size (pathology description)
1	98 mm × 65 mm × 66 mm	10 cm × 6 cm × 6 cm
2	44 mm × 25 mm × 26 mm	4 cm × 2 cm × 2 cm
3	50 mm × 36 mm	5.3 cm × 3.5 cm × 3.0 cm
4	100 mm × 56 mm	11 cm × 5 cm × 4 cm
5	89 mm × 126 mm	13 cm × 10 cm × 8 cm
6	20 mm × 15 mm × 18 mm	2 cm × 1 cm
7	92 mm × 15 mm × 65 mm	9 cm × 6 cm × 5 cm
8	31 mm × 23 mm	3.0 cm × 2.5 cm × 2.0 cm
9	44 mm × 37 mm	diameter 4.5 cm
10	53 mm × 75 mm × 59 mm	7 cm × 5 cm × 5 cm
11	75 mm × 43 mm × 55 mm	7.5 cm × 5.0 cm × 3.0 cm
12	122 mm × 118 mm × 53 mm	22 cm × 12 cm × 5 cm
13	70 mm × 58 mm × 32 mm	8 cm × 7 cm × 7 cm
14	63 mm × 35 mm	6.0 cm × 4.0 cm × 3.5 cm
15	75 mm × 65 mm × 72 mm	7cm × 6 cm × 7 cm
16	103 mm × 90 mm × 80 mm	11 cm × 9 cm × 7 cm
17	53 mm × 43 mm × 42 mm	5.5 cm × 4.5 cm × 4.0 cm
18	26 mm × 39 mm × 39 mm	4.0 cm × 3.0 cm × 2.5 cm
19	72 mm × 52 mm × 80 mm	7 cm × 6 cm × 5 cm
20	65 mm × 43 mm × 50 mm	6.5 cm × 5.0 cm × 4.0 cm
21	62 mm × 54 mm × 28 mm	6 cm × 5 cm × 2 cm
22	62 mm × 50 mm	diameter 6.8 cm

As shown in **Table 1**, the tumor sizes measured by MSCT were highly consistent with those of the surgical specimens. After analysis, no significant difference was found between the MSCT measurements and the postoperative pathology results ($P > 0.05$), as shown in **Figure 2**.

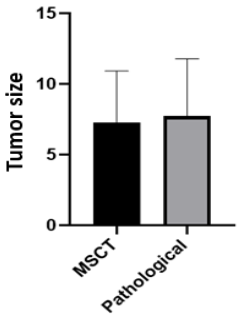

Figure 2. Comparison of tumor size based on MSCT and pathological analysis

Table 2 compares tumor density based on MSCT descriptions and risk classifications based on pathological findings.

Table 2. Patient's tumor density and risk classifications based on MSCT and pathological descriptions

No.	Tumor density based on MSCT descriptions (1 as no uniform reinforcement; 2 as uniform reinforcement)	Risk classifications based on pathological descriptions (1 as low risk; 2 as high risk; 3 as extremely high risk)
1	1	2
2	1	2
3	1	2
4	1	2
5	1	2
6	2	1
7	1	3
8	2	1
9	1	2
10	1	2
11	1	2
12	1	2
13	1	2
14	1	2
15	1	2
16	1	2
17	2	1
18	1	2
19	1	2
20	1	3
21	1	2
22	1	3

As shown in **Table 2**, the MSCT descriptions indicate that uniform tumor enhancement corresponds to low risk in the pathological results, while non-uniform enhancement correlates with high risk. After analysis, the tumor density differed significantly between low-risk and high-risk (including extremely high-risk) GISTs ($P < 0.05$), as shown in **Figure 3**.

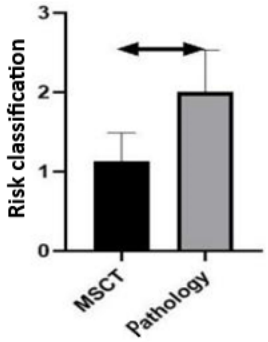

Figure 3. Relationship between tumor density and risk classification based on MSCT and pathological analysis

Table 3 compares MSCT examination results of tumor density with immunohistochemical classifications (CD117 and DOG-1 expression).

Table 3. Comparison of MSCT examination results of tumor density with immunohistochemical classifications

No.	Tumor density based on MSCT descriptions (1 as no uniform reinforcement; 2 as uniform reinforcement)	CD117 (1 as positive; 2 as negative)	DOG-1 (1 as positive; 2 as negative)
1	1	1	1
2	1	1	1
3	1	1	1
4	1	1	1
5	1	1	1
6	2	1	1
7	1	1	1
8	2	1	1
9	1	1	1
10	1	1	1
11	1	1	1
12	1	1	1
13	1	1	1
14	1	1	1
15	1	1	1
16	1	1	1
17	2	1	1
18	1	1	1
19	1	1	1
20	1	1	1
21	1	1	1
22	1	1	1

As shown in **Table 3**, both CD117 and DOG-1 were positive. Upon analysis, there was no significant difference between MSCT-detected uniform enhancement and CD117 or DOG-1 expression ($P > 0.05$), as shown in **Figure 4**.

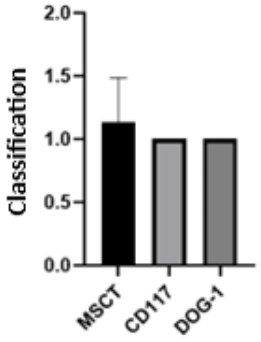

Figure 4. Comparison of tumor density classification with immunohistochemical classifications

Table 4 presents the pathological risk assessment for each patient.

Table 4. Pathological risk assessment for each patient

No.	Mass size (MSCT)	MSCT description (1 as clear; 2 as opaque)	Tumor density based on MSCT descriptions (1 as no uniform reinforcement; 2 as uniform reinforcement)	Risk classifications based on pathological descriptions (1 as low risk; 2 as high risk; 3 as extremely high risk)	CD117 (1 as positive; 2 as negative)	DOG-1 (1 as positive; 2 as negative)
1	98 mm × 65 mm × 66 mm	2	1	2	1	1
2	44 mm × 25 mm × 26 mm	2	1	2	1	1
3	50 mm × 36 mm	2	1	2	1	1
4	100 mm × 56 mm	2	1	2	1	1
5	89 mm × 126 mm	2	1	2	1	1
6	20 mm × 15 mm × 18 mm	1	2	1	1	1
7	92 mm × 15 mm × 65 mm	2	1	3	1	1
8	31 mm × 23 mm	1	2	1	1	1
9	44 mm × 37 mm	2	1	2	1	1
10	53 mm × 75 mm × 59 mm	2	1	2	1	1
11	75 mm × 43 mm × 55 mm	2	1	2	1	1
12	122 mm × 118 mm × 53 mm	2	1	2	1	1
13	70 mm × 58 mm × 32 mm	2	1	2	1	1
14	63 mm × 35 mm	2	1	2	1	1
15	75 mm × 65 mm × 72 mm	2	1	2	1	1
16	103 mm × 90 mm × 80 mm	2	1	2	1	1
17	53 mm × 43 mm × 42 mm	1	2	1	1	1
18	26 mm × 39 mm × 39 mm	2	1	2	1	1
19	72 mm × 52 mm × 80 mm	2	1	2	1	1
20	65 mm × 43 mm × 50 mm	2	1	3	1	1
21	62 mm × 54 mm × 28 mm	2	1	2	1	1
22	62 mm × 50 mm	2	1	3	1	1

As shown in **Figure 5**, the multiple characteristics of MSCT, such as tumor size, boundary, and density, as well as immunohistochemistry results, were significantly associated with high-risk GISTs after analysis ($P < 0.05$).

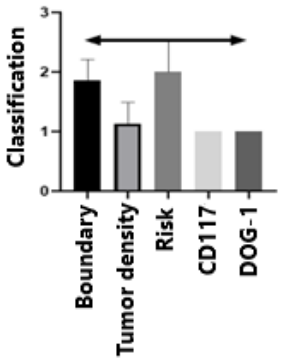

Figure 5. Classification of MSCT characteristics, risk, and immunohistochemistry results

4. Discussion

GIST is the most common stromal-derived tumor of the digestive tract. Imaging plays a crucial role in the diagnosis, treatment, and follow-up of GIST. Recently, MSCT has become an indispensable imaging method for GIST patients due to its rapid speed, high resolution, and powerful postprocessing capabilities. As a non-invasive method, MSCT provides images with high temporal and spatial resolution [3], allowing for a particularly clear visualization of GIST [4]. GIST typically appears as a well-demarcated, soft tissue density mass in MSCT scans. Smaller GISTs usually show uniform enhancement, while larger tumors may exhibit heterogeneous enhancement due to hemorrhage or necrosis. Intravenous contrast injection enables the observation of tumor vascular supply and blood flow dynamics, which aids in evaluating the tumor's malignancy and resectability. In particular, MSCT has demonstrated high application value in both diagnosing and assessing the risk of GIST. Through precise tumor size measurement and densitometric analysis, MSCT helps predict the biological behavior of GIST and the patient's treatment response. Moreover, combining MSCT characteristics with immunohistochemical results can further improve the accuracy of GIST risk assessment.

5. Conclusion

This study confirms that the MSCT examination provides a comprehensive and accurate assessment of GIST, including tumor size, density, immunohistochemical classification, and pathological risk. This information is critical for clinical decision-making, treatment planning, and prognosis evaluation. With its advantages of being non-invasive, rapid, and offering high-resolution imaging, MSCT plays a pivotal role in the diagnosis, preoperative evaluation, treatment monitoring, and follow-up of GIST patients [5]. As technology continues to advance, MSCT will remain crucial in GIST management, offering patients more accurate diagnostic information and optimized treatment strategies. Future studies may further explore the combined use of MSCT with other advanced imaging technologies to enhance the diagnosis and management of GIST.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Zhao Y, Wang Y, Wang J, et al., 2024, Progress in the Diagnosis and Treatment of Gastrointestinal Interstitial Tumor. Chinese Journal of General Surgery (Electronic Version), 18(1): 66–70.

[2] Li J, Zhang M, Liu Y, 2024, Investigation of GIST Risk Classification by Spectral CT Imaging Omics and CT Signs. Chinese Journal of CT and MRI, 2024(7): 156–159.

[3] Hua L, Huang Y, Liu H, et al., 2024, Diagnostic Value of High-Resolution Ultrasound Combined with Multi-Slice Computer Tomography (MSCT) for Pediatric Intra-Abdominal Hernias: A Retrospective Study. BMC Surg, 24(1): 190. https://doi.org/10.1186/s12893-024-02478-0

[4] Weeda YA, Kalisvaart GM, Hartgrink HH, et al., 2024, Monitoring Neoadjuvant Treatment-Induced Surgical Benefit in GIST Patients Using CT-Based Radiological Criteria. Surgery Open Science, 20: 169–177. https://doi.org/10.1016/j.sopen.2024.07.002

[5] Wei SC, Xu L, Li WH, et al., 2020, Risk Stratification in GIST: Shape Quantification with CT is A Predictive Factor. Eur Radiol, 30(4): 1856–1865. https://doi.org/10.1007/s00330-019-06561-6