Am J Transl Res 2022;14(11):8279-8285
www.ajtr.org /ISSN:1943-8141/AJTR0146879

Case Report

A case report of gastrointestinal stromal tumor of the duodenum

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Received October 8, 2022; Accepted October 28, 2022; Epub November 15, 2022; Published November 30, 2022

Abstract: Introduction: Gastrointestinal stromal tumors (GISTs) rarely occur in the duodenum, and only a few cases have been reported. Its clinical manifestations are not specific, and the imaging examination results are not typical, so a preoperative diagnosis is difficult. Pathologic examinations and genetic testing after surgical resection are the main diagnostic methods. Here, a case of duodenal stromal tumor complicated by gastrointestinal perforation is reported. A 57-year-old man presented with paroxysmal abdominal pain and bloating for 7 days. Contrast-enhanced computed tomography of the abdomen revealed a large mass (10 cm in diameter) in the right upper abdomen, which was considered neoplastic. The mass was anterior and inferior to the head of the pancreas, and medial to the mesenteric vessels. The tumor surrounded the descending and horizontal parts of the duodenum, and it ruptured into the lumen of the descending duodenum. After the patient underwent tumor resection, we found a rupture of the descending duodenal opening. After that, duodenal fistula drainage, gastrostomy, jejunostomy, small intestinal adhesion release and abdominal irrigation drainage were performed. Immunohistochemical staining results were as follows: CD34 (-), desmin (-), S-100 (-), CD117 (9.7) (+), DoG-1 (+), SDHB (+), Ki-67 (+5%). Based on these results, the lesion was finally diagnosed as duodenal GIST. The patient underwent surgical resection without targeted therapy and recovered well. Discussion: Duodenal stromal tumors often present with gastrointestinal bleeding and other clinical symptoms, requiring urgent surgery. Complete resection of the tumor is an effective surgical method. Extended resection does not prolong survival. However, surgical treatment should be determined according to the size and location of the tumor and its relationship to the pancreas. This highly malignant duodenal stromal tumor was >10 cm, accompanied by gastrointestinal perforation and necrosis. Surgical resection was required while protecting the organ function.

Keywords: Duodenum, gastrointestinal stromal tumor, perforation, surgery

Introduction

Gastrointestinal stromal tumors (GISTs) are the most common mesenchymal tumors of the gastrointestinal tract, accounting for 1-3% of all gastrointestinal malignancies [1]. Duodenal stromal tumors are rare tumors among GISTs, accounting for 4-5% of GISTs [2]. Most of them develop in people over 40 years old, and there is no obvious sex difference [3]. It is primarily located in the descending and horizontal parts of the duodenum, adjacent to the liver, pancreas, and other important organs, so it has special characteristics for diagnosis and treatment. Duodenal stromal tumors are usually asymptomatic in their early stages and found incidentally. As the tumor continues to grow, there may be abdominal pain, blood in the stool, abdominal mass, intestinal obstruction, and acute peritonitis caused by perforation [4].

KIT gene mutation is found in 75-80% of GISTs, and PDGRα mutation is found in 10-15% of GISTs [5]. After these mutations, the anti-apoptotic mechanism is abolished, which promotes rapid growth of tumor cells. Computed tomography (CT) is still the first routine examination for GISTs. It can be used not only for diagnosis and differential diagnosis, but also for evaluation of efficacy of targeted drugs and detection of tumor recurrence and metastasis. The final diagnosis relies on pathology, immunohistochemistry and molecular testing.

Surgery remains the preferred and effective treatment for GISTs. It is usually necessary to

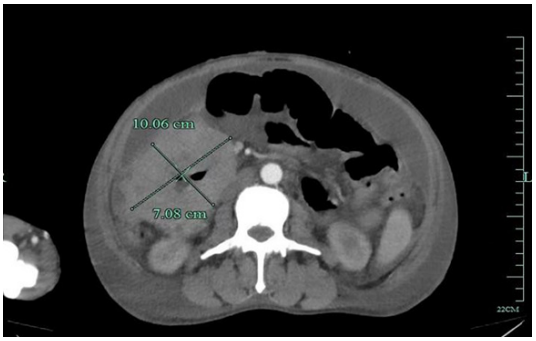

Figure 1. Image of abdominal computed tomography.

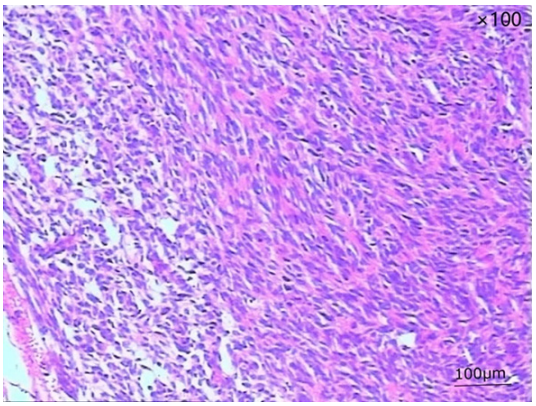

Figure 2. Tumor cell morphology (hematoxylin-eosin stain, × 100).

comprehensively consider the location, volume, and nature of the tumor, and the extent of invasion of surrounding tissues. The surgical principle of duodenal GISTs should be complete tumor resection to avoid tumor rupture and implantation metastasis [2, 6]. For duodenal GISTs in special locations requiring combined organ resection, if it is difficult to perform R0 resection, imatinib can be used for preoperative treatment [7]. Due to the relative rarity of duodenal GISTs, clinicians have little understanding about its clinical features, diagnosis, treatment and prognosis. In this study, we report a case of duodenal GIST with gastrointestinal perforation. Informed consent was signed by the patient.

Case report

A 57-year-old man presented with 7 days of abdominal pain accompanied by anorexia, without nausea, vomiting or melena. The pain was intermittent. He had a history of neurofibroma and a history of mental retardation. He was a non-smoker with no alcohol history. Physical examination found pale palpebral conjunctivae, yellowish skin, abdominal bulge, mass in the right upper abdomen and abdominal pain. His routine blood examination showed leukocytes 20.26 × 10^9/L, neutrophil ratio 90.6%, hemoglobin 47 g/L and platelets 528 × 10^9/L. Abdominal CT scan suggested a soft tissue tumor with the presence of peritoneal ascites in the right upper abdomen. After admission to the Department of General Surgery, he underwent contrast-enhanced CT scan of the abdomen (**Figure 1**), and the scan image revealed a soft tissue mass (10.06 cm × 7.08 cm) with areas of necrosis in the right upper abdomen, suggesting a stromal tumor. The pancreatic and the common bile ducts were dilated. The mass appeared to compress the descending part of the duodenum and the mesenteric vessels. An exploratory laparotomy and excision of the mass were performed. Intraoperatively, the abdomen and the pelvis were found with ascites. The mass (11.0 cm × 8.0 cm) was located posterior to the small intestinal mesenteric area in the right upper abdomen, with a brittle and hard texture. The surface of the mass broke and exuded into the abdominal cavity. The mass was located anteriorly below the head of the pancreas, medial to the vessels of the root of the mesentery. The tumor encircled the descending and horizontal parts of the duodenum, and in the region of the descending duodenum, tumor ruptured into the lumen. After resection of the tumor, further exploration revealed a ruptured opening in the descending duodenum of about 2.0 cm with bile and digestive fluid. With consent from his family, a right upper abdominal retroperitoneal tumor resection + duodenal fistula repair with tube drainage + gastrostomy + jejunostomy + small intestine adhesion release + abdominal flushing and drainage were performed, during which 2 units of blood were transfused intraoperatively. In terms of postoperative pathology, the tumor cell morphology is shown in **Figure 2**. Immunohistochemical results (**Figure 3**) were as follows, CD34 (-), desmin (-), S-100 (-), CD117 (9.7) (+), DOG-1 (+), SDHB (+), Ki-67 (+5%). The morphology of retroperitoneal mass combined with immunohistochemistry was consistent with gastrointestinal mesenchymal tumor of high risk type. Postoperatively, he recovered well without early significant complications and

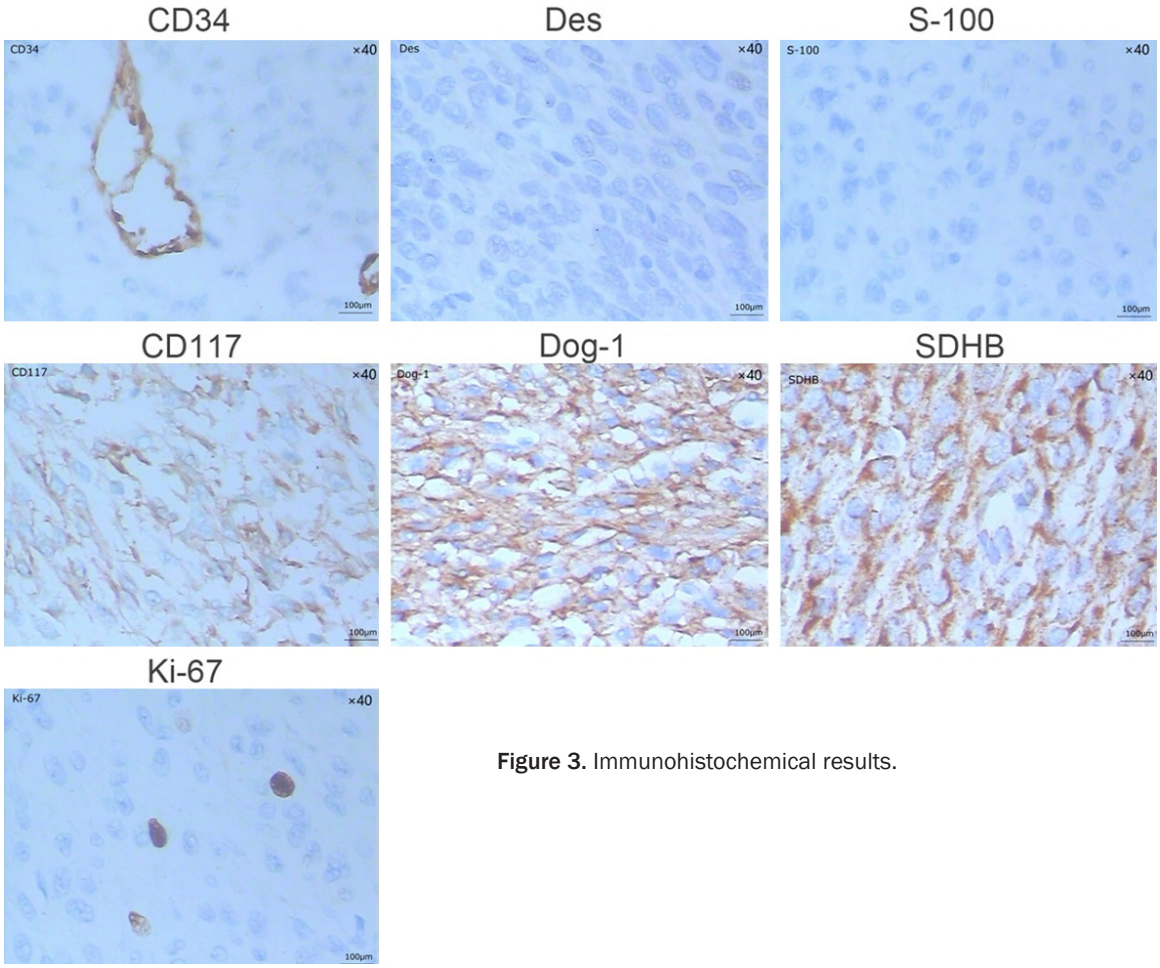

Figure 3. Immunohistochemical results.

did not need targeted therapy, and the hemoglobin gradually increased. The patient was discharged 10 days after the operation, and 4 months after the operation, he was well with no evidence of tumor recurrence.

Discussion

The global incidence of gastrointestinal stromal tumor (GIST) is about 1-1.5 per 100,000 [8]. There are about 20,000-30,000 newly diagnosed patients in China each year, and more than 100,000 patients are receiving treatment [8, 9]. GISTs can involve the entire gastrointestinal tract, of which the stomach accounts for 60%, small intestine 25%, rectum 5%, and colon, esophagus, omentum, mesentery, and retroperitoneum less than 5% [9]. The treatment of GIST mainly relies on surgery and molecular-targeted drugs.

GISTs have the ability for malignant transformation, and the risk is closely related to tumor size, location, and mitotic figures. GISTs are initially surrounded by normal tissues such as mucosa, serosa and muscularis propria, forming a protective biological barrier that avoids injury [10].

We retrieved relevant case reports in the PubMed database using gastrointestinal stromal tumor and duodenum as keywords and obtained 19 samples (**Table 1**). The analysis of 20 cases (19 cases retrieved plus our case) showed that duodenal GIST was more common in people over 50 years old. The patients were aged between 21 and 84 years, with 7 women and 13 men. Tumor size varied from 1.6 to 15 cm, with an average of 6.2 cm. The majority of the (11) tumors were located in the second part of the duodenum, and a small number of patients had tumor located in the first, third and fourth parts.

The manifestation of symptoms is mainly related to growth site, size, relationship to the gas-

Table 1. Literature review

Study	Age	Sex	Size	Duodenal portion location	Surgical treatment	Symptoms and sign at admission
Cavallini 2005 [14]	66	M	3.5	Second	Local resection	Anemia, melena
Mohiuddin 2007 [15]	56	M	10.0	Second	Local resection	Anemia, melena
Hecker 2010 [19]	58	M	15.0	Second	PD	Abdominal pain, anemia, weight loss
Mokhtare 2013 [35]	24	M	3.0	Third and fourth	Local resection	Acute upper gastrointestinal bleeding
Acar 2013 [21]	65	F	3.2	Third	Local resection	Abdominal pain
Kobayashi 2014 [36]	36	M	2.2	Second	PD	Loss of consciousness
Kumar 2015 [22]	55	F	15.0	Third	PD	Abdominal pain
Turculeț 2016 [13]	48	M	7.0	Second and third	PD	Melena, asthenia and dizziness
Jung 2017 [16]	72	M	6.5	NM	Local resection	Melena
Santos 2020 [37]	75	M	10.0	Third and fourth	PD	Asymptomatic
Sasaki 2020 [20]	68	M	2.4	Second	PD	Abdominal pain
Pyuza 2021 [38]	40	M	5.0	Third and fourth	Local resection	Asymptomatic
Inoue 2022 [4]	44	F	3.0	First	PD	Anemia
	84	M	3.5	Second	Local resection	Melena
Ito 2022 [12]	58	M	3.0	Second	Local resection	Anemia
	57	F	9.2	Second	Local resection	Ischemic colitis
Skhiri 2022 [17]	21	F	5.2	Second	PD	Abdominal pain, melena
Harhar 2022 [23]	54	F	6.3	Fourth	Local resection	Abdominal pain
Mita 2022 [18]	57	F	1.6	Second	Local resection	Melena

Note: PD indicatespancreaticoduodenectomy.

trointestinal wall, and whether the tumor is ruptured [11]. As the tumor grows, a pseudocapsule can be formed by compression of normal tissue, and necrosis or spontaneous rupture of the tumor can occur to a certain extent, leading to gastrointestinal perforation, hemorrhage and peritonitis [12]. Common symptoms are gastrointestinal bleeding, abdominal pain, melena, and abdominal mass. Early cases can be asymptomatic. Studies [12-18] have reported symptoms in 70,000 patients with melena. Five cases with anemia were reported [4, 12, 14, 15, 19]. Six patients (five cases from the literature plus our case) developed abdominal pain [17, 19-23].

Because of the atypical clinical manifestations of duodenal GIST, multiple examinations should be combined for diagnosis. GIST diagnosis mainly relies on CT, MRI, PET-CT, ultrasound endoscopy, and other related examinations. Endoscopic gastric GIST mainly shows submucosal local elevation, and is mostly spherical or hemispherical, with a smooth mucosal surface [24-26]. Large lesions may be accompanied by ulceration, necrosis, or bleeding [13]. Contrast-enhanced CT is the preferred imaging method for GIST, and can identify tumor location, size, growth mode, adjacent peripheral organs, blood supply, and distant metastasis. Low grade GIST is characterized by uniform density, sharp edge, rarely invasion of adjacent organs, and calcification [27]. When the grade of malignancy is high, the tumor has unclear boundaries, and can be adherent to adjacent organs, frequently with central necrosis, bleeding, cystic degeneration, and rare calcification [27, 28]. Liver metastases on enhanced CT can be further evaluated by MRI. Our case was not evaluated by MRI. In the 20 retrieved studies, 19 cases underwent tissue examination after surgical resection to confirm GIST. One case was diagnosed by endoscopic biopsy.

The final diagnosis relies on histopathologic and immunohistochemical examinations. Immunohistochemical routine detection includes CD117, DOG-1, CD34, S-100, SDHB and KI-67. The histopathologic results of this study were: CD34 (-), desmin (-), S-100 (-), CD117 (9.7) (+), DOG-1 (+), SDHB (+), and Ki-67 (+5%). CD117 is the protein product of the proto-oncogene c-kit, which has a positive expression rate of 94-98% in GISTs with good sensitivity and specificity. DOG-1 is the protein product of the proto-oncogene platelet-derived growth factor receptor α (PDGFRA), which has a positive expression rate of 94-98% in GISTs [29]. CD117 and

DoG-1 are important immunohistochemical markers for the diagnosis of GIST. Ki-67 is a marker of cell proliferation in a variety of malignancies, associated with poor pathologic features and aggressive behavior, and is prognistically important [30]. However, not all immunohistochemical markers are always positive. Harhar et al. [23] found that the tumor cells of a duodenal GIST did not express CD117, but expressed DOG-1 due to a PDGFRA mutation. Therefore, some cases that cannot be diagnosed by immunohistochemical examination can be further identified by mutational testing.

Currently, surgery is the treatment of choice for GIST, and the main surgical options are minimally invasive endoscopic surgery of the gastrointestinal tract, minimally invasive laparoscopic surgery, combined biomicroscopic surgery and traditional open surgery. Surgical resection is considered the main method to treat duodenal GIST. Pancreaticoduodenectomy and local resection (12) were performed in all reported cases. The surgical method is chosen mainly based on the size and location of the GIST. National Comprehensive Cancer Network Clinical Practice Guidelines for GISTs (Version 2. 2022) [27] suggested that surgical resection should be performed on tumors, with negative histological margins. Laparoscopic surgery is safe and feasible for GIST ranging from 5 to 10 cm in diameter and does not increase perioperative complications [27]. The Chinese Society of Clinical Oncology [28] recommends that tumors ≤ 2 cm can be assessed annually with endoscopic ultrasonography. R0 resection should be performed for tumors > 2 cm or with undesirable biologic behavior. The duodenal GIST case in this study was located in the second and third parts of the duodenum, and in the right upper retroperitoneum, with a diameter of 10 cm. Therefore, an R0 resection of the right superior retroperitoneal tumor was performed. The patient was well without tumor recurrence, and follow-up is ongoing. Marcella et al. [31] concluded that endoscopic submucosal dissection and laparoscopic approach have the same resection rate for GISTs with a diameter between ≤ 2 cm and 2-5 cm. However, Lei et al. [32] suggested that laparoscopic surgery may be more appropriate for gastric GISTs between 2 and 5 cm in diameter. The duodenum is the structure with the most complex adjacent anatomic relationship among the abdominal organs. In order to protect organ function, local surgery to remove the tumor should be attempted. On the basis of ensuring the complete resection of the tumor, extensive operation such as pancreaticoduodenectomy should be minimized [28].

For a GIST that cannot be resected or has metastases, targeted drug therapy is the main approach. However, if there is no progress in treatment, or if there is bleeding or obstruction, surgical resection may be required. Tyrosine kinase inhibitors are available for patients with unresectable, metastatic or recurrent GIST [16, 33]. Imatinib, sunitinib and regorafenib are first-, second- and third-line therapies for patients with GIST, respectively [28].

Malignant GISTs have a high recurrence and metastasis rate and an extremely poor prognosis. The 5-year survival rate after surgery for gastrointestinal mesenchymal tumors was found to be 30.5-73.2% [7, 34]. As screening equipment develops rapidly, the positive diagnosis rate of GISTs has increased significantly, and the clinical awareness of GIST is growing. Because of its aggressiveness, early detection and treatment are of value for patients.

Disclosure of conflict of interest

None.

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