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Gastric Plexiform Fibromyxoma: A Great Mimic of Gastrointestinal Stromal Tumor (GIST) and Diagnostic Pitfalls



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ABSTRACT

Through a multicenter study, we collected seven cases of gastric plexiform fibromyxoma including four females and three males, 21 to 79 y old (46.1 ± 10.1). All cases showed a unilocular lesion measuring 0.3 to 17 cm (5.3 ± 2.4), arising from antrum (5/7) or body (2/7). Six of the seven cases had intraoperative frozen sections and/or endoscopic ultrasound fine needle aspiration (EUS-FNA), and all of them were preoperatively or intraoperatively diagnosed as gastrointestinal stromal tumor (GIST). EUS-FNA material showed markedly elongated spindle cells with streaming oval to elongated nuclei with rounded ends. Histologically, the tumors exhibited a plexiform growth pattern and were composed of a rich myxoid stroma and cytologically bland uniform spindle cells without mitotic figures, with the exception of one case which displayed nuclear pleomorphism and increased mitosis. Immunostains showed the tumor cells to be focally positive for SMA (6/6), focally and weakly positive for desmin (3/6) and caldesmon (2/3), negative for CD117 (0/7), CD34 (0/7), DOG1 (0/4), and S100 (0/5). No mutations were identified on Next-Generation Sequencing test, and no loss of SDHB immunoreactivity was identified in the tumor with nuclear pleomorphism. One case was treated with Gleevec because of the initial diagnosis of GIST. All patients had a follow-up for up to 11 y, with no tumor recurrence or metastasis reported. Our results suggest that gastric plexiform fibromyxoma is rare and may be underrecognized and misinterpreted as GIST during

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intraoperative frozen section or preoperative EUS-FNA diagnosis without immunostains leading to inappropriate treatment.

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Introduction

Gastrointestinal stromal tumor (GIST) is the most common primary mesenchymal tumor of the stomach and spans a clinical spectrum from benign to malignant. GISTs have a broad morphological spectrum including the most commonly encountered spindle cell type, the less frequently epithelioid type, and mixed spindle and epithelial types with multiple histologic patterns including palisaded-vacuolated, sclerosing, discohesive, pseudopapillary, and myxoid patterns.¹ The majority of GISTs harbor a *KIT* (C-Kit) mutation, whereas a small portion has *PDGFRA* mutation and *SDH* deficiency.¹ Immunohistochemically, the majority of GISTs are positive for C-Kit/CD117 and Dog1 stains and frequently positive for CD34. Gastric plexiform fibromyxoma (GPF) is a rare benign mesenchymal neoplasm usually arising in the gastric antrum and clinically manifesting similar to a GIST. Only a few cases of GPF have been reported since the first case described in 2007 by Takahashi *et al.*²⁻⁷ The characteristic histologic features of GPF include multiple plexiform nodules containing paucicellular to moderately cellular myxoid, collagenous, or fibromyxoid stromal components.⁵ In contrast to GIST, GPF is negative for C-Kit/CD117, Dog1, and CD34.

So far, the reported GPF cases behave as a benign tumor with neither recurrence nor metastases after resection. However, their identification is challenging if their pre and intraoperative diagnosis is performed without immunostains. Because of their clinical and morphological similarities to myxoid variant GIST and the rarity of the disease, we hypothesized that GPF could be misdiagnosed as GIST during intraoperative frozen sections diagnosis or preoperative EUS-FNA diagnosis without the use of immunostains. To test this, we searched the databases of multiple medical centers across the country for cases with a final diagnosis of GPF since 2007. A total of seven cases in four major medical centers were identified. We recorded the diagnoses of intraoperative frozen sections and preoperative EUS-FNA if available, final diagnosis and current follow-up, and reviewed all of the slides including frozen sections, EUS-FNA smears, and permanent sections with immunostains. The clinical and radiographical findings and diagnostic pitfalls on correct diagnosis of this rare entity are discussed.

Materials and methods

Patient selection

Through a multicenter pathology database search for cases with a diagnosis of GPF from January 2007 to March 2018, a total of seven cases of GPF were identified at Cedars-Sinai Medical Center,² University of Florida,² University of California in Los Angeles,² and Washington University in St. Louis.¹ The seven patients include four males and three females with an age range of 21-79 y (46.1 ± 10.1). Six of the seven patients

underwent at least partial gastrectomy and had intraoperative frozen sections (5/6) and/or preoperative EUS-FNA (2/6) without immunostains (Table). One case (case #7) was recently diagnosed on the biopsy of a small polypoid gastric lesion with immunostains, and no further resection was performed. The slides of each case were reviewed by at least three pathologists (at least two from each institution and JL reviewed all of the cases). The study was approved by the IRB at Cedars-Sinai Medical Center with approved waiver of the consent.

Immunohistochemistry

Immunostaining for C-Kit/CD117, CD34, DOG1, smooth muscle actin (SMA), Desmin, and S100 was performed in seven GPFs. Tissue sections (4 μ m) were cut from paraffin-embedded tissue blocks and stained with antibodies against C-Kit/CD117 (Clone YR145; Cell Marque, Rocklin, CA, USA), CD34 (Clone QBEnd/10, Ventana, Tucson, AZ, USA), DOG1 (Clone K9, Leica, Chicago, IL, USA), SMA (Clone 1A4, DAKO, Carpinteria, CA, USA), Desmin (Clone DE-R-11, Ventana, Tucson, AZ, USA), and S100 (Clone ZO311, DAKO, DAKO, Carpinteria, CA, USA). Immunohistochemical staining was performed on the Ventana Benchmark Ultra (Ventana, Tucson, AZ, USA). Pretreatment was performed with antigen retrieval method as a routine procedure. The immunostain intensity was evaluated with a previously reported scoring system.^{8,9} The intensity of membranous and cytoplasmic staining was evaluated as follows: 1+, weak; 2+, moderate; and 3+, strong. The intensity was based on comparison with staining of external positive controls or internal positive controls (mast cells, endothelial cells, or smooth muscle from the muscularis mucosae).

Next generation sequencing

In case #3, because of the nuclear pleomorphism of the tumor cells, increased mitotic activity, and the negative SDHB immunostain, Next-Generation Sequencing (NGS) was performed in this GPF. The area of tumor was localized on an H and E slide and microdissected. Genomic DNA extracted from the tissue was sequenced using the GatorSeq NGS Panel and sequenced on the Illumina NextSeq to high uniform depth (targeting 500x coverage by non-PCR duplicate read pairs with > 99% of exons at coverage > 100x). The following genes were assayed: *ABL1*; *AKT1*; *ALK*; *ASXL1*; *BAALC*; *BCOR*; *BCR*; *BRAF*; *BRINP3*; *CBFB*; *CEBPA*; *CRLF2*; *CTNBN1*; *DDR2*; *DEK*; *DNMT3A*; *EGFR*; *ERBB2*; *ERG*; *ETV6*; *EZH2*; *FBXW7*; *FGFR1*; *FGFR2*; *FLT3*; *GNA11*; *GNAQ*; *HOXA9*; *HRAS*; *IDH1*; *IDH2*; *JAK2*; *KIT*; *KMT2A*; *KRAS*; *MAP2K1*; *MECOM*; *MET*; *MKL1*; *MLLT3*; *MN1*; *MPL*; *MYC*; *MYH11*; *NF1*; *NOTCH1*; *NPM1*; *NRAS*; *NUP214*; *PDGFRA*; *PHF6*; *PIK3CA*; *PML*; *PTEN*; *PTPN11*; *RAD21*; *RARA*; *RBM15*; *RET*; *RPN1*; *RUNX1*; *RUNX1T1*; *SF3B1*; *SMAD4*; *SMC1A*; *SMC3*; *SMO*; *SRSF2*; *STAG2*; *TET2*; *TP53*; *TSC1*; *U2AF1*; *U2AF2*; *WT1*; *ZRSR2*; *FLT3*; *NUP214*; *ALK*; *ERBB2*; *ASXL1*; *PML*; *TP53*; *KMT2A*; *MKL1*; *BCR*; and *PDGFRA*. Sequence data were processed using a

Table – Clinicopathological characteristics of gastric plexiform fibromyxomas.

Case #	Age (y)	Gender	Location	Size (cm)	FS/FNA	IHC						Follow-up
						C-kit	CD34	DOG1	SMA	Des	S100	
1	21	F	Body	17.0	GIST	-	-	n/a	+	-	-	4 y
2	42	F	Antrum	8.0	GIST	-	-	-	n/a	-	-	4 y
3	79	F	Antrum	3.7	GIST	-	-	-	+	+/-	-	1 y
4	33	M	Antrum	3.2	GIST	-	-	n/a	+	+/-	-	11 y
5	60	M	Antrum	1.6	GIST	-	-	-	+	+	-	1 y
6	77	M	Body	3.2	GIST	-	-	-	+	n/a	n/a	2 y
7	45	M	Antrum	0.3	n/a	-	-	-	+	n/a	n/a	.2 y

FS = frozen section; FNA = fine needle aspiration.

customized analysis pipeline (GatorSeq v1.0) designed to accurately detect base substitutions and insertions/deletions. Annotated reports were generated using GenomeOncology software and database. Human genome version hg19 was used as the reference and was downloaded from <http://ftp.broadinstitute.org/bundle/2.8/hg19>. The mutation nomenclature was based on the convention recommended by the Human Genome Variation Society (<http://www.hgvs.org/mutnomen/>).

Results

Clinical features of GPFs and 6/6 initially misdiagnosed as GIST

The seven patients included four female and three male, and they were 21 to 79 (46.1 ± 10.1) y. All cases showed a

unilocular lesion arising from antrum⁵ or body.² The tumor sizes ranged from 0.3 to 17 cm in greatest dimension. Information on radiographic studies of these tumors is limited. In case #1, the abdominal computed tomography (CT) scans showed a 17 cm hypoattenuating mass with a slightly enhanced rim in the left upper quadrant, radiologically worrisome for a mucinous malignancy from a gastric origin (Fig. 1A). The mass abutted and mildly displaced the pancreas from neck to tail, and the mass was in close contact with the greater curvature of the stomach and the colon splenic flexure. This patient underwent gastrectomy, distal pancreatectomy, splenectomy, and partial colectomy. Endoscopically, the lesions showed a polypoid mass in the stomach. Six of the seven cases had intraoperative frozen sections and/or preoperative EUS-FNA. The cytology examination of these cases showed spindle cells with markedly elongated light blue cytoplasm and light blue myxoid

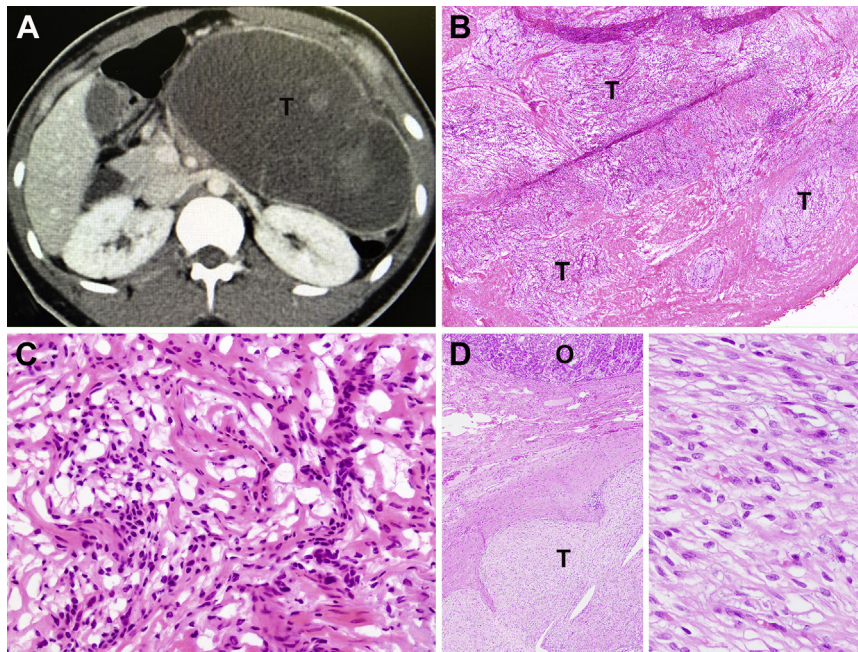


Fig. 1 – Gastric plexiform fibromyxoma case 1. (A), Axial CT scan showing a 17 cm hypoattenuating tumor (T) with slightly enhancing rim involving gastric body; (B and C), frozen section showing multiple flexiform myxoid tumor nodules (T) present in the muscularis propria with arborizing vascular architecture and intracytoplasmic vacuoles; (D), Permanent section of the tumor showing similar features and overlying oxyntic mucosa (O) (H and E stain: B and D left, 40×; C, 200×; D right, 400×). (Color version of figure is available online.)

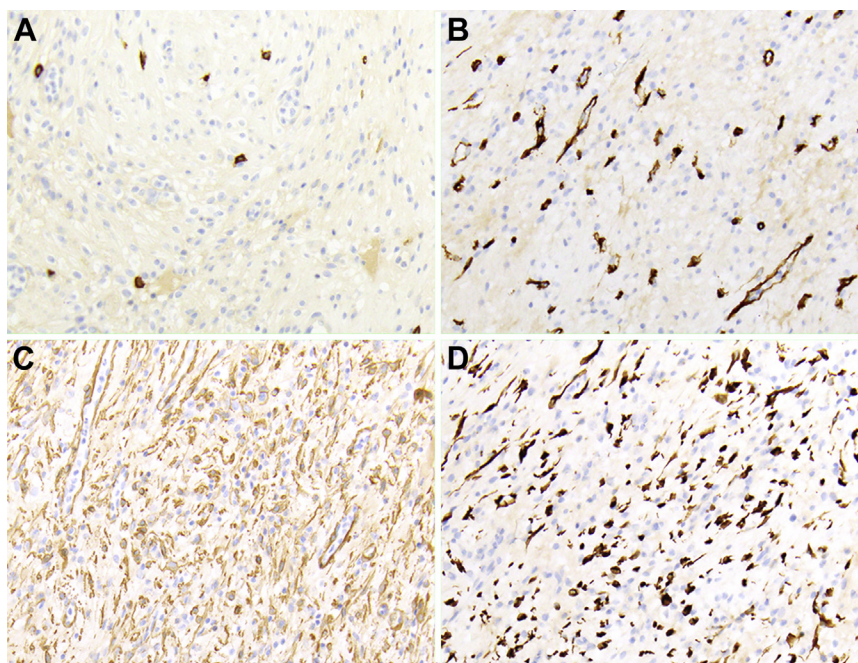


Fig. 2 – Immunoreactivity of GPF case 1 showing that the tumor cells are negative for CD117 (A), CD34 (B), focally positive for SMA (C), and negative for Desmin (D) (A-D, 200×). (Color version of figure is available online.)

stroma in Papanicolaou and Diff-Quik–stained material. The tumor cells displayed oval to moderately elongated nuclei with a fine homogenous chromatin and lack nucleoli. Most nuclei ends were rounded; the tumor nuclei did not display tapered and irregular ends. These cells were organized in bundles; and their nuclei showed a parallel

streaming pattern. These six cases were preoperatively or intraoperatively interpreted as GIST or probable GIST (Table). Case #7 was a recent biopsy case of an antral polypoid lesion. Follow-up was available on all cases, ranging from less than a year up to 11 y. No tumor recurrence or metastases were identified (Table).

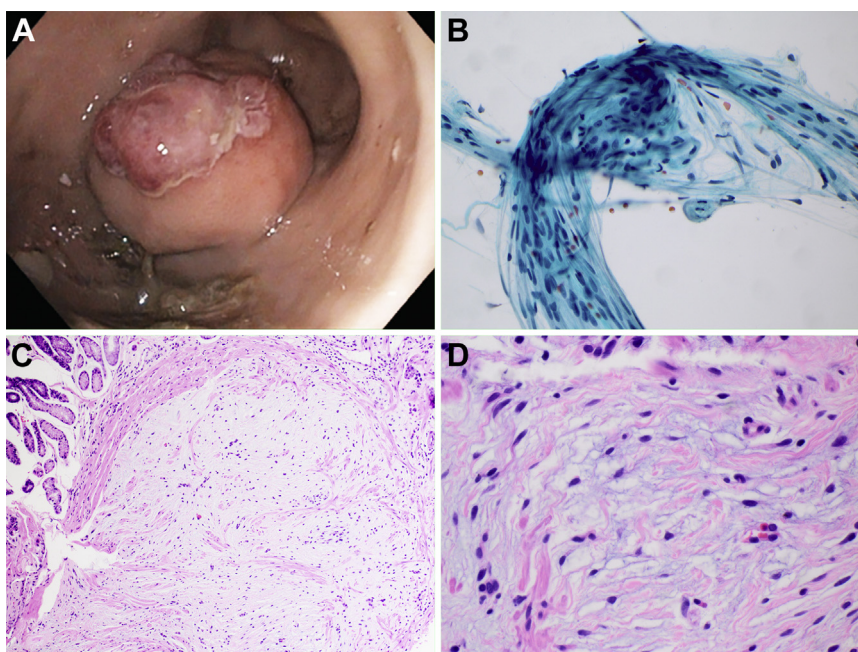


Fig. 3 – Gastric plexiform fibromyxoma case 2. (A), Endoscopic appearance showing an antral mass with surface erosion/ulceration; (B), FNA showing cytological bland spindle cell proliferation (Pap smear, 400×); (C and D), Resection of the mass showing cytological bland spindle cell proliferation with low cellularity in the myxoid stroma (H and E stain: C, 100×; D, 400×). (Color version of figure is available online.)

Histology and immunoprofile of GPFs

Histologically, the tumors exhibited the typical described histology, which was characterized by a plexiform growth pattern with nodules in the muscularis propria (Fig. 1B), infiltrative borders, and arborizing vascular architecture on frozen section (Fig. 1B and C). The tumors were composed of a rich myxoid stroma, and the majority (6/7) showed cytologically bland uniform spindle cells without mitotic figures identified (Fig. 1D). Two of seven cases showed gastric body with overlying oxyntic mucosa (Fig. 1D left) as the origin. Immunostains were performed in all the cases (Fig. 2). They were focally positive for SMA (6/6), focally and weakly positive for desmin (3/6) and caldesmon (2/3), negative for CD117 (0/7), CD34 (0/7), DOG1 (0/4), and S100 (0/5). SDHB immunoreactivity was intact in 2 of 2. Six of the seven cases were morphologically benign and showed a low Ki-67 proliferative index (< 2%) including the 17 cm one. More histopathology with matched FNA cytopathology and endoscopic experiences of GPFs were shown in Figure 3.

One unusual case of GPF with a synchronous GIST

Case #3 was unusual. In this patient, a 3.7 cm GPF and a synchronous separate and isolated 0.7 cm GIST were identified from the partial gastrectomy specimen. The GPF showed low to moderate cellularity arising from antrum (Fig. 4A) with nuclear pleomorphism and three mitotic figures per 10 high-power fields (Fig. 4B), but no lymphovascular invasion, perineural invasion, or metastasis was identified. The GPF was negative for C-Kit/CD117 (Fig. 4C), DOG1 (Fig. 4D left), CD34, and S100 but positive for SMA and focally positive for desmin.

SDHB immunoreactivity was intact in the GPF tumor cells. The Ki-67 proliferative index was 30%. Phospho-histone H3 highlighted six positive cells in a 5 mm² area (Fig. 4D right). In contrast, the separate and incidental GIST was cytologically bland with calcification and typical spindle cell morphology of GIST with no mitotic figures identified (Fig. 5A and B) and strong and diffuse positivity for C-Kit/CD117 (Fig. 5C), DOG1 (Fig. 5D), and CD34. The ki-67 proliferative index was 1%. NGS was performed and no pathologic mutations or variants were identified in the GPF. This was a consultation case and the patient was treated with Gleevec for the initial diagnosis of GIST at an outside institution. During clinical follow-up, at the time of preparation of this article, the patient had cardiac dysfunction and sepsis, but no tumor recurrence or metastasis was identified.

Discussion

GPF is a rarely reported benign mesenchymal neoplasm seen in the gastric antrum. Because of clinical and morphological similarity to myxoid variant of GIST and the rarity of the disease, we tested the hypothesis that GPF could be misdiagnosed as GIST during intraoperative frozen section examination and/or preoperative EUS-FNA diagnosis if immunostains were not employed. The findings in this case series include: 1) 100% (6/6) of GPF were misinterpreted as GIST in preoperative EUS-FNA and/or during intraoperative frozen section; 2) up to 30% of GPF may originate from the gastric body; 3) Rarely, GPF can have unusual histology such as nuclear pleomorphism and synchronously coexist with GIST in the same gastrectomy specimen. These are the diagnostic

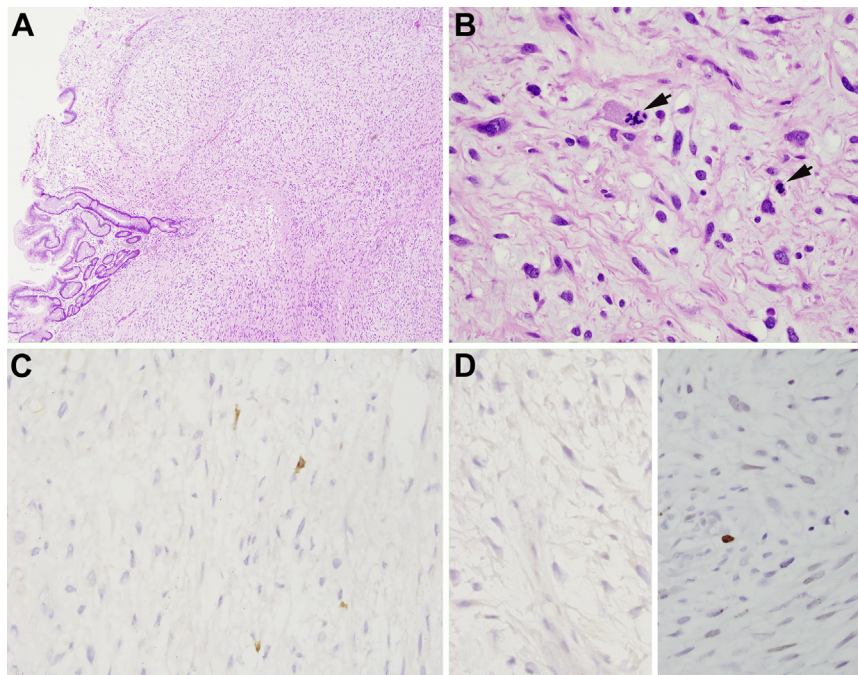


Fig. 4 – Gastric plexiform fibromyxoma case 3. (A and B), H and E–stained section of the tumor showing transmurality involvement by plexiform myxoid tumor with nuclear pleomorphism and increased mitotic figures (Arrows); (C and D), Immunohistochemistry showing the tumor cells are negative for CD117 (C), DOG1 (D left). PHH3 highlights six positive cells in a 5 mm² area (D right) (A, 40×; B–D, 400×). (Color version of figure is available online.)

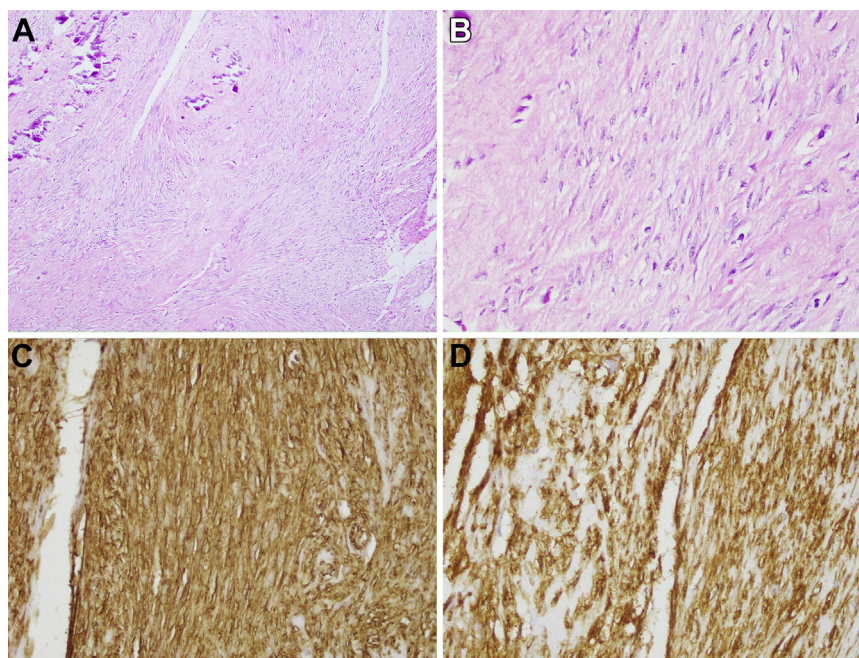


Fig. 5 – Synchronous GIST in case 3. (A and B), H and E–stained section of the tumor showing a spindle cell neoplasm with no mitotic activity; (C and D), Immunohistochemistry showing the tumor cells are positive for CD117 (C) and DOG1 (D) (A, 40×; B-D, 400×). (Color version of figure is available online.)

challenges and pitfalls and may lead to inappropriate clinical management.

Plexiform fibromyxoma is a distinctive benign gastric neoplasm that should be separated from GIST, nerve sheath tumors, and other fibromyxoid/spindle cell neoplasms.³ Histologically, typical GPF is a plexiform intramural growth with multiple micronodules containing paucicellular to moderately cellular myxoid, collagenous, and fibromyxoid neoplastic stromal elements. A prominent plexiform pattern is typically present. The tumor cells varied from oval to spindled and had limited atypia and mitotic activity < 5/50 high-power fields.^{3,4} In review of our cases, the typical histologic patterns were present on the frozen sections. Misinterpretation of these tumors as GISTs is likely a result of lack of awareness of this entity and the fact that GIST is a far more common tumor with similar morphology. In contrast to GIST, GPF is consistently negative for c-Kit (CD117), DOG1, CD34, desmin, and S100 protein on immunostains.³

On fine needle aspiration (FNA) material, the GPF cytology is strikingly similar to GIST but there are some subtle differences. GPF tumors show markedly elongated spindle cells with oval to elongated streaming nuclei and myxoid background. In cytology specimens, the differential diagnosis includes smooth muscle proliferations, GIST, and tumors of neural origin such as schwannoma and neurofibromas. Aspirates from smooth muscle proliferations such as leiomyoma show tridimensional clusters of cells with spindle morphology; most leiomyoma cells show with oval to elongated nuclei with rounded ends. Leiomyosarcomas are identified by their nuclear pleomorphism and mitoses. Smooth muscle tumor cells express SMA, desmin, and h-caldesmon. GIST aspirates show also tridimensional clusters of spindle cells or epithelioid cells with cohesive and loose patterns;

parallel and streaming arrangements of cells and nuclei may be seen. The nuclei may show oval to elongated irregular-shaped nuclei with a fine to coarse chromatin; some tumors may show striated nuclei. GIST cells cytoplasm may show a distinctive delicate fibrillary appearance with wispy cytoplasmic extensions. Bipolar cytoplasmic processes as well as perinuclear cytoplasmic vacuoles may be seen. In addition, GIST aspirates may show focally myxoid background and loosely fibrillary and pink to magenta stromal material on Romanowsky-type stains. GIST cells express c-kit (CD117), DOG1, and CD34.¹ Neural origin tumors show spindle cells with elongated nuclei with tapered to irregular pointed ends (wavy to fishhook-like). Schwannomas may show nuclear palisading and clear patterns identifiable as Verocay bodies. Neurofibromas may show distinct spindled fibroblasts and myxoid stroma. Both neural tumors are positive for S100. In two of our cases, preoperative EUS-FNA aspiration was performed with smears for cytology assessment. However, no immunostains were performed on the cell blocks or cell blocks may not have been available. The cytopathologic diagnosis was spindle cell proliferation consistent with GIST because of a clinical impression of GIST in these two cases. One of the two also had intraoperative frozen section diagnosis of GIST. Therefore, utilization of a panel of immunomarkers including CD117, CD34, DOG1, SMA, Desmin, and S100 should be performed on the cell blocks of spindle cell specimens from EUS-FNA of the stomach for a definite diagnosis of GIST.

Plexiform fibromyxoma is a distinctive mesenchymal neoplasm that occurs almost exclusively in the gastric antrum/pylorus region.¹⁻⁶ In our case series, two of seven patients had the GPF in the gastric body by imaging and endoscopic findings and histology confirmed overlying oxyntic mucosa in multiple sections of these two GPFs. Therefore,

GPF can also occur in the gastric body. This is consistent with another recently reported case of a histologically confirmed GPF with imaging findings of a cystic-solid well-circumscribed extraluminal mass located in the posterior wall of the gastric upper body.⁷

Reportedly, no KIT or platelet-derived growth factor receptor alpha (PDGFR α) mutations were identified in the three examined cases.³ A recent study also mentioned that the gene glioma-associated oncogene homologue 1 (GLI1) may be present in a subgroup of these tumors.¹⁰ In our series, we had an unusual consultation case that has nuclear pleomorphism, increased mitotic activity with three mitotic figures in 10 high-power field with six PHH3 positive cells in 5 mm² area, and 30% of Ki-67 proliferation index as well as a synchronous 0.7 cm GIST. This tumor did not show lymphovascular invasion or perineural invasion. The patient was previously treated with Gleevec for initial diagnosis of GIST and experienced some side effects. Currently, the patient has been followed-up for 1 y since her diagnosis and showed no evidence of tumor recurrence or metastasis. Because of its unusual morphology, we performed next generation sequencing for this GPF, but no C-kit, PDGFRA, or other mutations are identified. We also performed immunohistochemistry for SDHB to rule out a small possibility of SDH deficient-GIST, but the tumor showed intact expression of SDHB. To the best of our knowledge, this is the first documented case with coexistence of GPF and GIST.

In summary, our case series of GPF demonstrated that this entity can be underrecognized or misinterpreted without the pathologists' awareness of this entity and performing adequate immunostains. Misinterpreting GPF as GIST can lead to inappropriate treatment including unnecessary surgery and/or chemotherapy such as imatinib (Gleevec), which is an expensive and, in the case of GPF, ineffective treatment with a potential for adverse side effects. In addition to the originally report predilection of this tumor in the antrum, it can also arise from the body. No malignant cases have previously been reported in the English literature. One of our cases with nuclear polymorphism, increased mitotic activity, and high Ki-67 index is still being followed-up, yet shows no recurrence or metastasis to date.

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Authors' contributions: J.L. reviewed the slides, collected and analyzed the data, wrote and finalized the article. J.K. reviewed the slides and made the pathologic diagnosis for one case and reviewed the article. D.C. reviewed the slides and article and collected data for one case. D.Z. reviewed the

article and collected some data. S.Z. reviewed the slides and collected some data. M.L. reviewed the article and modified the discussion in the cytopathology part. A.S. collected some data and reviewed the article. W.L. reviewed the article. J.T. reviewed the article. P.S. interpreted the results of the molecular tests. D.G. made the diagnosis of one case. H.W. collected data for two cases and reviewed the article. X.L. reviewed and finalized the article. X.F. collected data for two cases, reviewed, and finalized the article.

Disclosure

All authors have read and approved the article and declare that they have no financial conflicts of interest.

REFERENCES

- Miettinen M, Fletcher CD, Kindblom LG, Tsui WM. Mesenchymal tumours of the stomach. In: Bosman FT, Carneiro F, Hruban R, Teise ND, eds. *WHO Classification of Tumours of the Digestive System*. Lyon: IARC; 2010:74–79.
- Takahashi Y, Shimizu S, Ishida T, et al. Plexiform angiomyxoid myofibroblastic tumor of the stomach. *Am J Surg Pathol*. 2007;31:724–728.
- Miettinen M, Makhlof HR, Sobin LH, Lasota J. Plexiform fibromyxoma: a distinctive benign gastric antral neoplasm not to be confused with a myxoid GIST. *Am J Surg Pathol*. 2009;33:1624–1632.
- Duckworth LV, Gonzalez RS, Martelli M, Liu C, Coffin CM, Reith JD. Plexiform fibromyxoma: report of two pediatric cases and review of the literature. *Pediatr Dev Pathol*. 2014;17:21–27.
- Wambura C, Surani S. Plexiform fibromyxoma: a rare gastric tumor. *Case Rep Gastrointest Med*. 2017;2017:4014565.
- Szurian K, Till H, Amerstorfer E, et al. Rarity among benign gastric tumors: plexiform fibromyxoma - report of two cases. *World J Gastroenterol*. 2017;23:5817–5822.
- Yang MX, Zhao ZH, Yang JF, et al. Imaging findings of gastric plexiform fibromyxoma with a cystic change: a case report and review of literature. *Medicine (Baltimore)*. 2017;96:e8967.
- Lai JP, Robbins PF, Raffeld M, et al. NY-ESO-1 expression in synovial sarcoma and other mesenchymal tumors: significance for NY-ESO-1-based targeted therapy and differential diagnosis. *Mod Pathol*. 2012;25:854–858.
- Lai JP, Conley A, Knudsen BS, Guindi M. Hypoxia after transarterial chemoembolization may trigger a progenitor cell phenotype in hepatocellular carcinoma. *Histopathology*. 2015;67:442–450.
- Spans L, Fletcher CD, Antonescu CR, et al. Recurrent MALAT1-GLI1 oncogenic fusion and GLI1 up-regulation define a subset of plexiform fibromyxoma. *J Pathol*. 2016;239:335–343.