Case Report
pISSN 1738-2637 / eISSN 2288-2928
J Korean Soc Radiol 2014;70(1):47-52
http://dx.doi.org/10.3348/jksr.2014.70.1.47

대한영상의학회지

Plexiform Angiomyxoid Myofibroblastic Tumor of the Stomach: Report of a Case and Review of the Literature[1]

위에 생긴 총상 혈관점액성 근섬유모세포종: 증례보고 및 문헌고찰[1]

Soo-Heui Baek, MD[1], Jung-Hee Yoon, MD[1], Ji-Yeon Kim, MD[2]

Departments of [1]Radiology, [2]Pathology, Haeundae Paik Hospital, Inje University College of Medicine, Busan, Korea

We report a case of a plexiform angiomyxoid myofibroblastic tumor of the stomach that developed in a 38-year-old woman who underwent gastrofiberscopy and multi-detector computed tomography scans due to dyspepsia for 3 months. There was a subepithelial protruding mass with a small central mucosal ulceration and heterogeneous prominent enhancement in the gastric upper body along the greater curvature. The tumor measured 3.5 × 2.3 cm in size and showed a multinodular plexiform growth pattern of bland spindle cells in the myxoid stroma with abundant small blood vessels. The tumor cells were negative for CD117 (c-KIT), CD34, and S-100 protein but diffusely positive for smooth muscle actin and Alcian blue. The pathologic examination demonstrated that the lesion was a plexiform angiomyxoid myofibroblastic tumor. The patient is doing well and has had no recurrence or metastasis for 6 months after the wedge resection.

Index terms
Plexiform Angiomyxoid Myofibroblastic Tumor
Stomach
Gastrointestinal Stromal Tumor
Myofibroblasts
Plexiform

Received August 20, 2013; **Accepted** October 21, 2013
Corresponding author: Jung-Hee Yoon, MD
Department of Radiology, Haeundae Paik Hospital, Inje University College of Medicine, 875 Haeundae-ro, Haeundae-gu, Busan 612-896, Korea.
Tel. 82-51-797-0355 Fax. 82-51-797-0379
E-mail: radyjh@hanmail.net

INTRODUCTION

A plexiform angiomyxoid myofibroblastic tumor (PAMT) is a recently described and extremely rare mesenchymal tumor of the stomach. Only 24 cases have been reported in the English literature (1-10) since it was first described by Takahashi et al. (1) in 2007. This tumor is characterized by a plexiform nodular growth of bland spindle cells in the myxoid or fibromyxoid stroma.

PAMT is a benign gastric neoplasm with clinicopathological characteristics that are distinct from gastrointestinal stromal tumors and other mesenchymal tumors of the stomach.

Here, we describe a case of PAMT presenting with a subepithelial gastric tumor detected on preoperative endoscopy, and we also present data from multi-detector computed tomography (MDCT) and a review of the literature.

CASE REPORT

A 38-year-old woman with the clinical impression of a subepithelial tumor of the stomach, which was detected during a health screening examination, visited the Inje University Haeundae Paik Hospital for further evaluation of the lesion. A MDCT scan was performed to characterize the focal gastric lesion. MDCT included an arterial phase scan and a portal phase scan with a 30° left posterior oblique position for appropriate distension and preparation of the lower two-thirds of the stomach, as well as a delayed scan in the right decubitus position for better visualization of the gastric fundus.

Arterial, portal phase, and delayed phase scans were followed with a 15-s delay after attenuation of the aorta at the thoracolumbar junction had reached 100 Hounsfield unit and a fixed 70-s de-

lay, 120-s delay, respectively, after the intravenous injection of 150 mL of iopromide (Ultravist 370; Bayer Schering Pharma, Berlin, Germany) administered at a rate of 3 mL/s with an autonomic injector.

The MDCT scan demonstrated a 3.5 × 2.3 cm-sized polypoid mass with prominent contrast enhancement in the high body along the greater curvature (Fig. 1A-C). The enhancement pattern was heterogeneous. Some portions demonstrated highly vascular prominent enhancement, while other portions showed lesser degrees of enhancement. No enlargement of any lymph node was observed in the regional or distant area. Upon endoscopy, a 3.5 × 2.3 cm sized luminal protruding polypoid subepithelial tumor lesion with central mucosal ulceration was found at the upper body, posterior wall and greater curvature side of the stomach (Fig. 1D).

A wedge resection was performed given the sufficient margin. The tumor was an unencapsulated soft tissue mass located at the submucosal layer of the stomach. The resected specimen contained mucinous material within the mass. The tumor was microscopically characterized on low power by a multinodular plexiform growth pattern (Fig. 2A). The tumor cells were bland spindle cells in the myxoid stroma with abundant small blood vessels (Fig. 2B). The tumor cells were positive for smooth muscle actin (SMA) (Fig. 2C), and a special stain for Alcian blue (Fig. 2D) showed a positive reaction in the myxoid stroma. Additional immunohistochemistry for CD117 (c-KIT), CD34, and S-100 proteins were negative in the tumor cells, excluding the possibility of a gastrointestinal stromal tumor (GIST) or neurogenic tumor. Based on the characteristic multinodular plexiform growth pattern, bland spindle cells, positive-form SMA and Al-

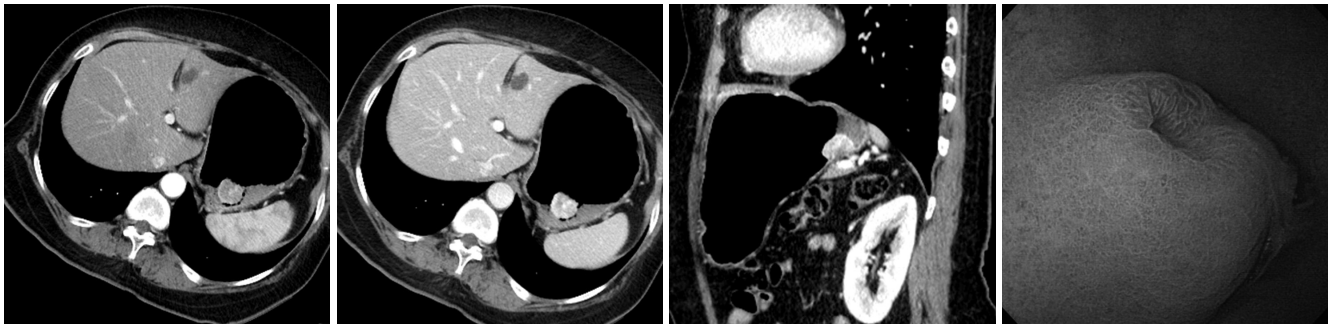

Fig. 1. A 38-year-old woman with an incidentally detected subepithelial tumor of the stomach.
A–C. MDCT scan axial image at the late arterial phase **(A)**, delayed phase **(B)**, sagittal-reconstructed scan **(C)** demonstrating a 3 × 2 cm-sized sessile polypoid mass with prominent contrast enhancement in the high body along the greater curvature. The enhancement pattern is heterogeneous, with some portions demonstrating a highly vascular enhancement and some portions showing a lesser degree of enhancement.
D. Upon endoscopy, a 3 × 2 cm-sized luminal protruding polypoid subepithelial tumor lesion with central mucosal ulceration is found at the upper body, posterior wall and greater curvature side of the stomach.
Note.—MDCT = multi-detector computed tomography

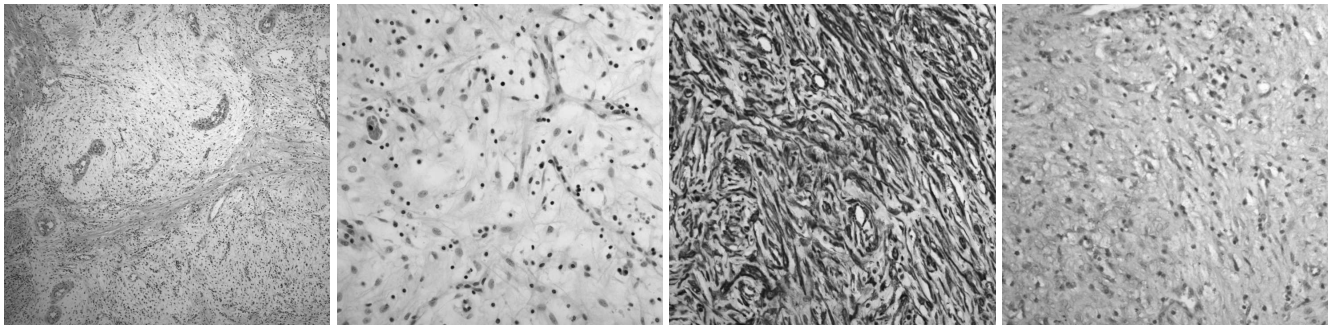

Fig. 2. A 38-year-old woman performed wedge resection for an incidentally detected subepithelial tumor of the stomach.
A. Upon histopathology (Hematoxylin and Eosin, × 100), the tumor is characterized by multinodular plexiform growth pattern.
B. The tumor is composed of bland-looking spindle cells scattered in the myxoid stroma rich in small vessels (Hematoxylin and Eosin, × 400).
C. Immunohistochemically, the tumor cells are positive for smooth muscle actin (× 400).
D. The myxoid stroma is positive under alcian blue staining (× 400).

cian blue-positive myxoid stroma rich in small vessels, the gastric tumor was diagnosed as PAMT of the stomach. The postoperative course was uneventful, and the patient is alive without any recurrence or metastasis of the tumor after a 6-month follow-up.

DISCUSSION

PAMT of the stomach is a recently described unique gastric mesenchymal tumor that is myofibroblastic in origin and has the potential to differentiate into smooth muscle cells. The tumor cells are bland and plexiform-arranged in a myxoid stroma. The diagnosis of PAMT is based on the histological feature of plexiform architecture, an abundant myxoid stroma rich in small blood vessels, and immunohistochemical findings. Reported cases fall under the various diagnostic names of "PAMT" (1, 2), "plexiform fibromyxoma" (3), and "plexiform angiomyxoid tu-

Table 1. Clinicoradiologic Features of 24 Reported and Present Case of Gastric Plexiform Angiomyxoid Myofibroblastic Tumor

No.	Age (yr)	Gender	Clinical Symptom	Location	Size (cm)	Ulcer	CT Findings	Treatment	Follow-Up	Reference
1	50	M	Acute abdominal pain (perforation)	Antrum	4	No	None	DG	No data	Takahashi et al. (1)
2	68	M	Incidental	Antrum	4.5	No	None	PG	Alive (12 mo)	Takahashi et al. (1)
3	52	M	Dyspepsia	Antrum	3.5	Yes	None	WR	Alive (5 mo)	Kim et al. (2)
4	38	F	Upper GI bleeding	Antrum	3	Yes	None	DG	No data	Miettinen et al. (3)
5	62	M	Weight loss	Antrum, pyloric	4	No	None	PG	No data	Miettinen et al. (3)
6	75	F	Unknown	Antrum	5	Yes	None	STG	Died of unknown causes (2 mo)	Miettinen et al. (3)
7	65	F	Weight loss, ulcer	Antrum, duodenal bulb	5	Yes	None	PG	Died of unknown causes (14.5 yr)	Miettinen et al. (3)
8	33	M	Anemia	Antrum	5.5	Yes	None	DG	Alive (19.7 yr)	Miettinen et al. (3)
9	43	M	Upper GI bleeding	Antrum	5.5	Yes	None	PG	Alive (18.4 yr)	Miettinen et al. (3)
10	56	F	Unknown	Pylorus, duodenal bulb	5.5	No	None	PG	Alive (19.9 yr)	Miettinen et al. (3)
11	50	M	Gastric outlet obstruction	Antrum, duodenal bulb	7	No	None	DG	Died of unknown causes (25.5 yr)	Miettinen et al. (3)
12	21	M	Anemia, syncope	Antrum, duodenal bulb	9	Yes	None	Antrectomy	Alive (22 yr)	Miettinen et al. (3)
13	16	F	Hematemesis	Antrum, pylorus	10	Yes	None	DG	Alive (3 yr)	Miettinen et al. (3)
14	30	F	Nonhealing ulcer	Antrum	10	Yes	None	DG	Alive (24 yr)	Miettinen et al. (3)
15	7	F	Diarrhea, mass	Antrum, duodenal bulb	15	No	None	Excision	No data	Miettinen et al. (3)
16	19	F	Incidental	Antrum	4.5	No	None	DG	Alive (9 mo)	Yoshida et al. (4)
17	46	M	UGI bleeding	Antrum	3.5	Yes	None	DG	Alive (4 mo)	Yoshida et al. (4)
18	23	M	Pain, tarry stool, discomfort (perforation)	Antrum, duodenal bulb	14	Yes	None	PG	Alive (12 mo)	Takahashi et al. (5)
19	54	F	Abdominal pain	Fundus	1.5	Yes	None	Endoscopic resection	Alive (6 mo)	Wang et al. (6)
20	63	F	Incidental	Low body	2.2	Yes	None	Endoscopic resection	No data	Kang et al. (7)
21	47	M	Incidental	Mid body	3	Yes	Prominent	WR	Alive (6 yr)	Kang et al. (7)
22	35	F	Incidental	Antrum	4	No	Poorly enhanced	DG	Alive (12 mo)	Sing et al. (8)
23	50	F	Morning nausea	Antrum	1.8	Yes	None	Excision	Alive (3 mo)	Rau et al. (9)
24	61	M	Hematemesis	Antrum	3.7	Yes	None	PG	No data	Galant et al. (10)
25	35	F	Incidental	High body	3.5	Yes	Prominent	WR	Alive (6 mo)	Present case

Note.—DG = distal gastrectomy, GI = gastrointestinal, PG = partial gastrectomy, STG = subtotal gastrectomy, UGI = upper gastrointestinal, WR = wedge resection

mor" (4), and almost all cases have focused on a pathological review. This case is the first report to focus on radiologic findings.

Table 1 summarizes the clinicoradiological features of the previously reported cases, including our unpublished case. To date, there is no sex predilection, and the tumors have occurred over a wide range of ages (7-75 years, mean; 44 years). PAMTs range in size from 1.5 to 15 cm with a mean of 5.5 cm. A very characteristic feature is its common location in the gastric antrum (1-5, 8-10). The tumor can extend to the pylorus and may also involve the duodenal bulb. However, PAMTs can occur anywhere in the stomach, including the fundus (6) or body (7), similar to our case. Ulceration or gastrointestinal bleeding is a common clinical presentation, and two cases of gastric perforation have been reported (1, 5). The surface of the tumor is eroded or ulcerated in approximately two-thirds of cases. The gross appearance resembles a lobulated, sometimes multinodular, white, red, or brown submucosal or transmural mass. Rather than projecting intraluminally, the mass often protrudes toward the serosal surface. CT findings have been described in only three cases, including the present case; one other case demonstrated prominent enhancement, but the other showed poor enhancement, conflicting with the first. We expect that a PAMT would be relatively well enhanced on a CT scan, as the stroma is rich in small vessels; however, the reported data are insufficient to reach this conclusion.

Distal or partial gastrectomy, wedge resection, and even endoscopic resection (6, 7) are performed for treatment. If preoperative endoscopic tissue sampling is accurately performed, the tumor can be treated by endoscopic resection. In all 24 reported cases to date, no recurrence or metastasis of the disease has occurred, although tumors have reached a size of up to 15 cm at its greatest dimension (3).

Nevertheless, the follow-up duration was too short in some cases to precisely predict the prognosis. Although the number of reported PAMT cases is small, malignant changes, metastasis to adjacent organs, and recurrence or death from disease have not yet been reported; therefore, it has been regarded as a benign tumor.

Radiological differential diagnosis of this disease entity includes GIST, leiomyoma, schwannoma, well-differentiated gastric endocrine tumor, ectopic pancreas, and inflammatory fibroid polyp. Because all of these neoplasms arise in the gastric wall, their radiological features may be similar. Because a GIST is the most common subepithelial tumor of the stomach, other subepithelial tumors can be mistaken for a GIST. Many studies have reported imaging findings of benign subepithelial tumors distinguished from GISTs by their potential malignancy (11-17).

GIST is the most common subepithelial tumor of the stomach, and the incidence of PAMT is estimated by Miettinen et al. (3) at less than 1 in 150 compared with that of gastric GIST. In our case, as the tumor was located in the submucosa and proper muscle layer, the most important differential diagnosis was GIST. Most cases of GIST occur in patients > 50 years of age at the time of presentation, and GISTs are rarely observed in patients < 40 years of age (11). The tumors have a smooth mucosal surface and are generally intact in the overlying mucosal surface, with exception of the focal areas of ulceration. GISTs mainly present as an extragastric extension of the tumor, approximately 86% into the gastrohepatic ligament, gastrosplenic ligament or lesser sac. A focal intraluminal polypoid mass resembling a mucosal polyp is the least common appearance of GISTs, representing approximately 14% of the GISTs (12). GISTs consist of spindle cells that are arranged in short fascicles and/or epithelioid cells that are arranged in organoid clusters or sheets (1). GIST does not show a distinctive plexiform intramural growth pattern, and PAMTs have less eosinophilic cytoplasm than GISTs. Moreover, compared to the tumor cell populations found in GIST, the stromal component is prominent; the immunohistochemistry of PAMT is clearly distinguished from GIST, being negative for CD117 (c-KIT) and CD34. Approximately 90% of GISTs are positive for CD117 (c-KIT) immunohistochemically.

Gastric leiomyoma is the second most common subepithelial gastric tumor and particularly frequently develops in the gastric cardia and high body. Thus, another important differential diagnosis in this case is gastric leiomyoma. Mainly, gastric leiomyomas shows a lobulated, contoured, protruding luminal mass mimicking the present case, but the mass manifests as poorly enhanced and homogeneously correlated with the liver, unlike our case, and is rarely in combination with surface ulcerations (13). Gastric leiomyoma is characterized by the fascicular arrangement of tumor cells that possess spindle-shaped nuclei and markedly eosinophilic cytoplasm (1). Leiomyomas are positive for SMA, desmin, and focally for CD34.

Gastric schwannoma is histologically characterized by long fascicular arrangements of bundled spindle cells that often have

a distinctive lymphoid cuff, which may contain germinal centers and stain positive for S-100. Although small gastric schwannomas and GISTs show similar imaging findings.

Well-differentiated gastric neuroendocrine tumors (carcinoids) are most commonly observed in the gastric antrum and manifest as one or more small intraluminal subepithelial masses with a characteristic central ulceration, which was consistent with the present case (15). They are manifested as avid enhancement in the early phase of dynamic contrast-enhanced CT, and consequently, they are less prominent in the portal venous and equilibrium phases. They have a small-sized monotonous neuroendocrine cell nest that histologically suggests a population of neuroendocrine tumors, with abundant cytoplasm and round, smooth-contoured nuclei. Immunohistological staining for chromogranin and synaptophysin also suggest a neuroendocrine tumor.

Gastric glomus tumors are exclusively manifested at the gastric antrum and show peripheral nodular or strong homogeneous enhancing vascular tumors in the arterial phase and prolonged enhancement in the delayed phase (16). Characteristically, these tumors have thicker normal overlying mucosa than other subepithelial gastric tumors and are immunohistochemically positive for CD34 and SMA. PAMT may be a well enhanced tumor due to the numerous small blood vessels observed in the myxoid stroma; hence, it is able to mimic vascular tumors.

An ectopic pancreas is another example of an intraluminal protruding tumor that is manifested with good enhancement; these appear as pancreatic tissue that contains the central umbilicus. However, most ectopic pancreases develop at the gastric antrum within 3 cm from the pylorus and demonstrate oval or flat tumors (17).

Inflammatory fibroid polyps are rare, benign, tumor-like lesions of the gastrointestinal tract. They are most commonly localized to the gastric antrum, usually present in the sixth or seventh decade, but arise from the submucosa and project into the bowel lumen. As in the present case, the mucosal surface is usually ulcerated. These polyps are composed of epithelioid- to spindle-shaped fibroblast proliferations in an onion-skin like pattern around the vessels and are infiltrated with inflammatory cells such as eosinophils, lymphocytes, macrophages, and mastocytes. The present case showed a lack of this infiltration by inflammatory cells, distinguishing it from a case of inflammatory fibroid polyps. All types of gastric subepithelial tumors except for GISTs are negative for CD117 (c-KIT). Inflammatory fibroid polyps are usually positive for CD34, and GIST, leiomyoma, glomus tumor, and schwannoma show focally positivity for CD34, but this PAMT case was negative for CD34; therefore, this present case could be distinguished from an inflammatory fibroid polyp immunohistologically.

In conclusion, we described a case of PAMT, a rarely reported distinctive benign subepithelial tumor of the stomach. This tumor is characterized by its common combination with mucosal surface ulceration, heterogeneously prominent enhancement, and antral involvement (although not observed in the present case). Signs of this tumor indicate the histological characterization of a multinodular plexiform growth pattern, proliferation of bland spindle cells, and the numerous small blood vessels observed in the myxoid stroma. The myofibroblastic nature of the tumor cells was confirmed by immunohistochemistry. In general, PAMT tumor cells are positive for SMA, and the myxoid stromal matrix is positive for Alcian blue. These histological and immunohistochemical features are helpful when diagnosing this rare disease. Our report may help to increase the awareness of this rare but important new disease entity.

REFERENCES

1. Takahashi Y, Shimizu S, Ishida T, Aita K, Toida S, Fukusato T, et al. Plexiform angiomyxoid myofibroblastic tumor of the stomach. *Am J Surg Pathol* 2007;31:724-728
2. Kim A, Bae YK, Shin HC, Choi JH. Plexiform angiomyxoid myofibroblastic tumor of the stomach: a case report. *J Korean Med Sci* 2011;26:1508-1511
3. Miettinen M, Makhlouf 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
4. Yoshida A, Klimstra DS, Antonescu CR. Plexiform angiomyxoid tumor of the stomach. *Am J Surg Pathol* 2008;32:1910-1912; author reply 1912-1913
5. Takahashi Y, Suzuki M, Fukusato T. Plexiform angiomyxoid myofibroblastic tumor of the stomach. *World J Gastroenterol* 2010;16:2835-2840
6. Wang WY, Li JN, Li GD. Plexiform angiomyxoid myofibroblastic tumour of the gastric fundus: successful diagnosis

and treatment by endoscopy. *J Clin Pathol* 2010;63:569-570
7. Kang Y, Jung W, Do IG, Lee EJ, Lee MH, Kim KM, et al. Plexiform angiomyxoid myofibroblastic tumor of the stomach: report of two cases and review of the literature. *Korean J Pathol* 2012;46:292-296
8. Sing Y, Subrayan S, Mqadi B, Ramdial PK, Reddy J, Moodley MS, et al. Gastric plexiform angiomyxoid myofibroblastic tumor. *Pathol Int* 2010;60:621-625
9. Rau TT, Hartmann A, Dietmaier W, Schmitz J, Hohenberger W, Hofstaedter F, et al. Plexiform angiomyxoid myofibroblastic tumour: differential diagnosis of gastrointestinal stromal tumour in the stomach. *J Clin Pathol* 2008;61:1136-1137
10. Galant C, Rousseau E, Ho Minh Duc DK, Pauwels P. Re: Plexiform angiomyxoid myofibroblastic tumor of the stomach. *Am J Surg Pathol* 2008;32:1910; author reply 1912-1913
11. Miettinen M, Sarlomo-Rikala M, Lasota J. Gastrointestinal stromal tumors: recent advances in understanding of their biology. *Hum Pathol* 1999;30:1213-1220
12. Levy AD, Remotti HE, Thompson WM, Sobin LH, Miettinen M. Gastrointestinal stromal tumors: radiologic features with pathologic correlation. *Radiographics* 2003;23:283-304, 456; quiz 532
13. Lee MJ, Lim JS, Kwon JE, Kim H, Hyung WJ, Park MS, et al. Gastric true leiomyoma: computed tomographic findings and pathological correlation. *J Comput Assist Tomogr* 2007;31:204-208
14. Choi JW, Choi D, Kim KM, Sohn TS, Lee JH, Kim HJ, et al. Small submucosal tumors of the stomach: differentiation of gastric schwannoma from gastrointestinal stromal tumor with CT. *Korean J Radiol* 2012;13:425-433
15. Lee NK, Kim S, Kim GH, Jeon TY, Kim DH, Jang HJ, et al. Hypervascular subepithelial gastrointestinal masses: CT-pathologic correlation. *Radiographics* 2010;30:1915-1934
16. Kim JK, Won JH, Cho YK, Kim MW, Joo HJ, Suh JH. Glomus tumor of the stomach: CT findings. *Abdom Imaging* 2001;26:303-305
17. Kim JY, Lee JM, Kim KW, Park HS, Choi JY, Kim SH, et al. Ectopic pancreas: CT findings with emphasis on differentiation from small gastrointestinal stromal tumor and leiomyoma. *Radiology* 2009;252:92-100

위에 생긴 총상 혈관점액성 근섬유모세포종: 증례보고 및 문헌고찰[1]

백수희[1] · 윤정희[1] · 김지연[2]

저자들은 소화불량을 호소하는 38세 여자의 위에서 생긴 총상 혈관점액성 근섬유모세포종 1예를 경험하였고 이의 위내시경, multi-detector computed tomography 소견을 문헌고찰과 함께 보고하고자 한다. 이 종괴는 위의 대만곡을 따라 상위체부에서 발생한 점막하 돌출형 종괴로 일부 중심 표면 궤양을 보이는 3.5 × 2.3 cm 크기의 불균질한 현저한 조영증강을 보이고, 풍부한 소혈관과 점액성 간질 내에 방추상세포가 섞인 다결절성 총상 형태의 성장을 보였다. 종양 세포는 CD117 (c-KIT), CD34, S-100 protein 염색에 음성으로, smooth muscle actin과 alcian blue 염색에 양성을 보여 면역조직학적으로 총상 혈관점액성 근섬유모세포종으로 진단되었다. 환자는 위 설상절제술 후 6개월간 재발이나 전이 없이 지내고 있다.

인제대학교 의과대학 해운대백병원 [1]영상의학과, [2]병리과