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【 CASE REPORT 】

Pancreatic Schwannoma Diagnosed by Endoscopic Ultrasound-guided Fine-needle Aspiration

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Abstract:
A schwannoma is a tumor originating from Schwann cells. It is occasionally observed in the abdominal viscera in the form of a submucosal tumor derived from the gastric or duodenal muscularis propria. To date, only a few studies have reported on pancreatic schwannomas. Furthermore, very few patients are preoperatively diagnosed with pancreatic schwannoma because of the lack of established imaging characteristics distinguishing this type of schwannoma from other conditions. We herein report the first English publication of pancreatic schwannoma in which surgery was avoided because a pathological diagnosis was made solely on the basis of endoscopic ultrasound-guided fine-needle aspiration findings.

Key words: pancreatic schwannoma, pancreatic neoplasm, endoscopic ultrasound-guided fine-needle aspiration

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Introduction

A schwannoma is a tumor originating from Schwann cells and was first reported by Verocay et al. in 1910 (1). Although a schwannoma can develop in any part of the human body, frequent sites of tumor growth include the extremities, body trunk, head and neck, and retroperitoneum (2). It is occasionally observed in the abdominal viscera in the form of a submucosal tumor, which is derived from the gastric or duodenal muscularis propria. To date, only a few studies have reported on pancreatic schwannomas. Furthermore, an extremely small number of patients are preoperatively diagnosed with pancreatic schwannoma because of the lack of established imaging characteristics that help distinguish this type of schwannoma from other conditions.

We herein report a case of pancreatic schwannoma in which surgery was avoided because a pathological diagnosis was made solely on the basis of endoscopic ultrasound (EUS)-guided fine-needle aspiration (FNA) findings. An imaging-based diagnosis was challenging, as nonspecific imaging findings were observed.

Case Report

A 73-year-old woman was receiving treatment for hypertension and hyperlipidemia. She had been found to have an enlarged pancreatic duct on abdominal ultrasonography, which was performed during a health examination. An 8-mm low-echogenic mass with poor blood flow was observed in the pancreatic body on EUS performed at an outside hospital (Fig. 1A). The caudal pancreatic duct diameter was 2 mm. On contrast-enhanced EUS, the pancreatic mass showed an avascular pattern in the initial phase. As typical findings of ductal adenocarcinoma (such as dilation of the distal pancreatic duct) were not observed, the patient did not undergo any intervention and was only placed under observation.

Two months thereafter, EUS was repeated. An anechoic area with suspected cystic changes, which had not been ob-

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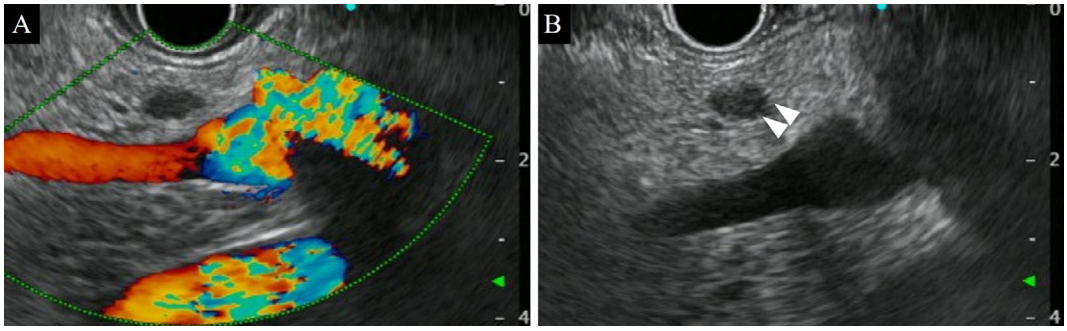

Figure 1. **Endoscopic ultrasound (EUS). A: An 8-mm low-echogenic mass with poor blood flow is observed in the pancreatic body on initial EUS. B: EUS repeated two months later reveals an anechoic area (arrowhead) suspected of being a cystic change on the boundary of the tail side of the mass, which had not been observed previously.**

Table 1. **Clinical Characteristics.**

White blood cells (/μL)	3.7×10^3
Red blood cells (/μL)	4.37×10^6
Hemoglobin (g/dL)	14.1
Platelet (/μL)	17.4×10^4
Total bilirubin (mg/dL)	1.0
AST (IU/L)	21
ALT (IU/L)	21
LDH (IU/L)	170
ALP (IU/L)	190
γ-GTP (IU/L)	17
Total protein (g/dL)	6.6
Albumin (g/dL)	4.2
Urea nitrogen (mg/dL)	12.2
Creatinine (mg/dL)	0.64
Sodium (mEq/L)	141
Potassium (mEq/L)	4.0
CEA (ng/mL)	1.4
CA19-9 (IU/mL)	12
DUPAN-2 (IU/mL)	<25
Span-1 (IU/mL)	9.9
Elastase-1 (ng/dL)	<80
NSE (ng/mL)	17.9
proGRP (pg/mL)	42.2

AST: aspartate aminotransferase, ALT: alanine aminotransferase, LDH: lactate dehydrogenase, ALP: alkaline phosphatase, γ-GTP: γ-glutamyl transpeptidase, CEA: carcinoembryonic antigen, CA19-9: carbohydrate antigen 19-9, DUPAN-2: duke pancreatic monoclonal antigen type 2, Span-1: s-pancreas antigen-1, NSE: neuron-specific enolase, proGRP: pro-gastrin-releasing peptide

served previously, was found in the boundary of the pancreatic tail (Fig. 1B). A high signal intensity was observed on diffusion-weighted magnetic resonance imaging (MRI). As the possibility of small pancreatic cancer could not be ruled out, the patient was referred to our hospital for a further examination.

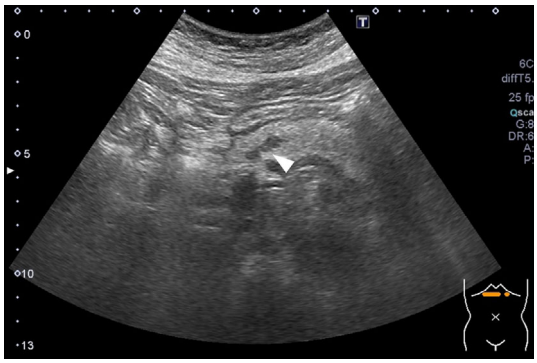

Figure 2. **Abdominal ultrasound. A bilocular low-echogenic mass (arrowhead) with clear margins and a major axis of 10 mm is observed in the pancreatic body.**

There were no abnormalities in the patient's vital signs or on physical examination. The patient's laboratory test results are shown in Table 1. Neuron-specific enolase (17.9 ng/mL) was slightly elevated. A bilocular low-echogenic mass with clear margins and a major axis of 10 mm was observed in the pancreatic body on abdominal ultrasound (Fig. 2). A 9-mm, low-density area with relatively clear margins was observed in the arterial phase of dynamic computed tomography (CT). Compared to the surrounding pancreatic parenchyma, the area was contrasted strongly in the equilibrium phase (Fig. 3). The pancreatic mass was hypo-intense on T1-weighted MRI, slightly hyper-intense on T2-weighted MRI, and hyper-intense on diffusion-weighted MRI. The cystic component was not clear on MRI. No abnormalities were observed in the formation of the major pancreatic duct on magnetic resonance cholangiopancreatography (MRCP) (Fig. 4). Based on these imaging findings, pancreatic cancer without involvement of the main pancreatic duct, pancreatic neuroendocrine neoplasm, and solid-pseudopapillary neoplasm (SPN) were considered as potential diagnoses.

To make a definitive diagnosis pathologically, we performed an EUS-FNA. A 22-gauge biopsy needle (Acquire™; Boston Scientific, Marlborough, USA) was used, and a puncture was performed twice via a trans-gastric ac-

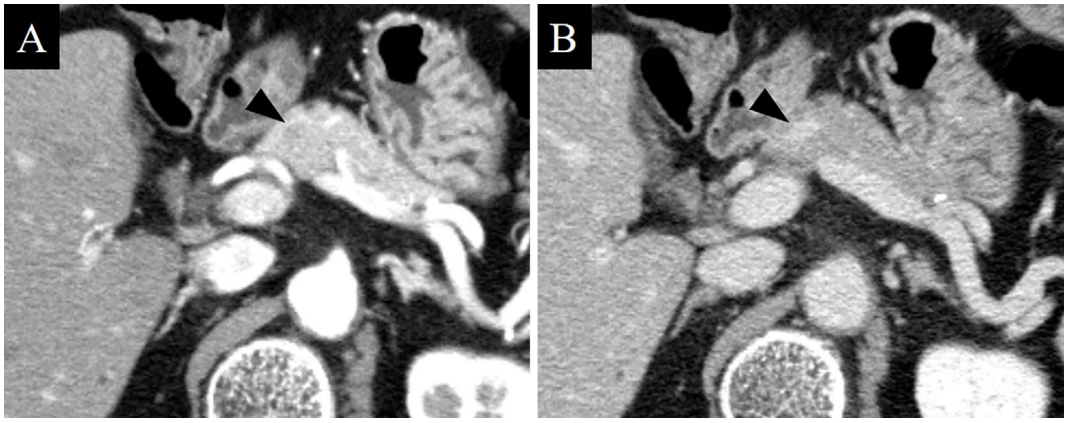

Figure 3. **Dynamic computed tomography. A: A 10-mm low-density area (black arrowhead) with relatively clear margins is observed in the pancreatic body in the arterial phase of dynamic computed tomography. B: Compared with the surrounding pancreatic parenchyma, the mass (black arrowhead) shows strong contrast in the equilibrium phase.**

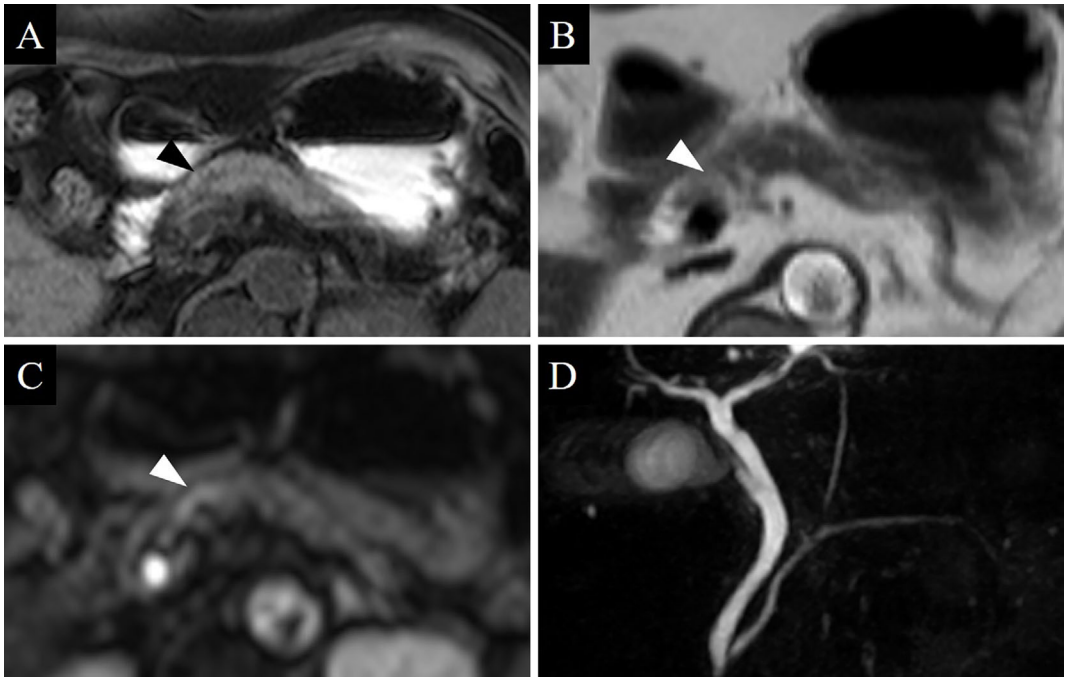

Figure 4. **Magnetic resonance imaging and magnetic resonance cholangiopancreatography (MRCP). A: A T1-weighted image shows a low signal intensity (arrowhead) in the pancreatic body. B: A T2-weighted image shows a slightly high signal intensity (arrowhead) in the pancreatic body. C: A diffusion-weighted image shows a high signal intensity (arrowhead) in the pancreatic body. D: An MRCP image shows no abnormalities in the formation of the major pancreatic duct.**

cess route under 20-cc suction pressure (Fig. 5). Pathological specimens were acquired via sample isolation by stereomicroscopy, as previously reported (3). Histopathological findings indicated palisading proliferation of spindle cells and nuclear palisading. The neoplastic cells were positive for S-100 protein and neural cell adhesion molecule and negative for α-smooth muscle actin, heavy caldesmon, and CA19-9. The cells had an MIB-1 labeling index of less than 1%. Based on these findings, we pathologically diagnosed the patient with pancreatic schwannoma, a benign tumor (Fig. 6).

The patient was observed with no surgical requirements. No significant changes were noted during the six-month observation period following the definitive diagnosis.

Discussion

Schwannomas can be divided into two histopathological types: highly cellular Antoni type A and sparsely cellular Antoni type B. Schwannoma cells are strongly positive for S-100 proteins, vimentins, and CD56, and negative for cytokeratins, AE1/AE3, desmin, smooth muscle myosins,

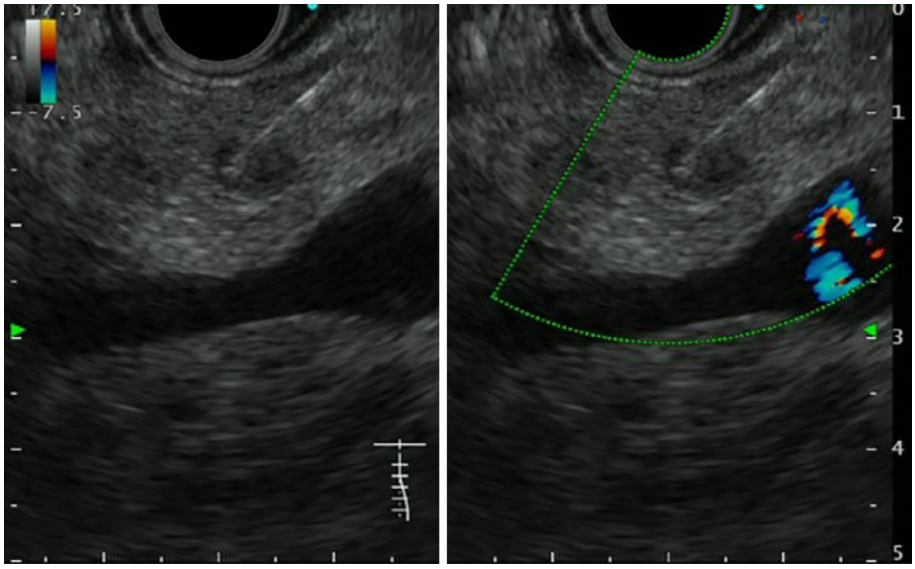

Figure 5. **Endoscopic ultrasound-guided fine-needle aspiration. A 22-gauge needle (Acquire™; Boston Scientific) is used via a trans-gastric access route.**

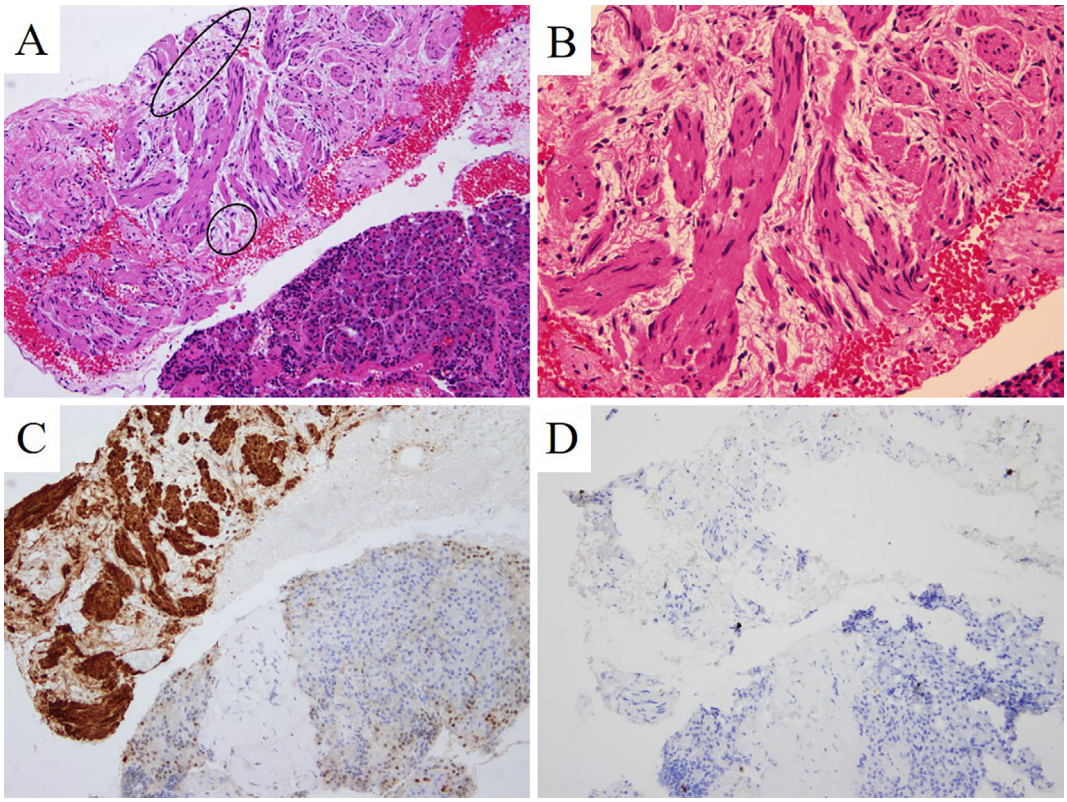

Figure 6. **Hematoxylin and Eosin (H&E) staining and immunostaining. All pathological specimens were acquired via sample isolation by stereomicroscopy. A: H&E staining ×100. Antoni type B areas (circle) are sparsely cellular with few vessels. B: H&E staining ×200. Palisading proliferation of spindle cells and nuclear palisading is observed. C: Immunostaining (S-100 protein) ×100 shows positive results. D: An MIB-1 labeling index of less than 1% is observed.**

CD34, and CD117 (4).

Imaging can be performed to diagnose a pancreatic schwannoma, including ultrasonography, CT, and MRI, which are also used to diagnose other pancreatic tumors. A mixture of solid components and cystic components is frequently observed on CT (5), reflecting the histological characteristics of schwannomas. As Antoni type A areas are highly cellular, they appear as solid components. On contrast CT, these areas are uneven due to the development of small-vessel components. Antoni type B areas, which are

Table 2. Reports of Pancreatic Schwannomas with a Size of up to 20 mm.

Case	Reference	Age/ sex	Symptoms	Location	Size (mm)	Primary diagnosis	EUS-FNA	Treatment	Follow-up (months)
1	8	71/M	Abdominal pain	Head	15	Cystic neoplasm	N/A	Enucleation	10
2	9	72/M	Abdominal pain	Head and body	10	Pancreatic mass	N/A	Surgery	N/A
3	10	37/M	Asymptomatic	Body	16	Pancreatic mass	Successful	Surgery	N/A
4	11	54/F	Abdominal pain	Head	14	Pancreatic mass	N/A	PD	N/A
5	12	63/F	Abdominal pain	Tail	10	NR	N/A	DP	N/A
6	13	55/F	Asymptomatic	Neck	10	Pancreatic mass	Successful	Follow-up	3
7	14	83/M	Asymptomatic	Body	20	Pancreatic mass	Successful	Follow-up	N/A
8	15	59/F	Asymptomatic	Body	16	Pancreatic cystadenoma	Unsuccessful	CP	53
9	16	53/M	Asymptomatic	Body	18	Pancreatic mass	Successful	Follow-up	N/A
10	17	59/F	Abdominal distention	Head	20	SPN, NEN, SCN	N/A	SSPPD	10
11	18	78/F	Asymptomatic	Body	17	Pancreatic mass	Successful	Follow-up	11
12	19	54/F	Asymptomatic	Head and body	20	SPN	Unsuccessful	DP	N/A
13	20	37/M	Abdominal pain	Body	13	NR	Successful	CP	5
14	20	43/F	Asymptomatic	Uncinate	16	IPMN	Unsuccessful	PD	14
15	21	44/F	Asymptomatic	Uncinate	13	Pancreatic mass	Successful	Follow-up	48
16	22	55/F	Abdominal distention	Body	20	Pancreatic cystadenoma	N/A	DP	12
17	23	79/M	Asymptomatic	Body	9	NEN, SPN	Successful	Follow-up	36
18	Our case	73/F	Asymptomatic	Body	10	NEN, SPN, pancreatic cancer	Successful	Follow-up	3

N/A: not available, NR: not reported, SPN: solid pseudopapillary neoplasm, NEN: neuroendocrine neoplasm, SCN: serous cystic neoplasm, IPMN: intraductal papillary mucinous neoplasm, PD: pancreatoduodenectomy, SSPPD: subtotal stomach-preserving pancreatoduodenectomy, DP: distal pancreatectomy, CP: central pancreatectomy

sparsely cellular with few vessels, appear as poorly contrasted pseudo-cysts. Furthermore, a previous study found that intravascular thrombosis tends to occur in Antoni B areas, leading to necrosis and thereby resulting in the formation of cysts (6). An area with a mixture of such solid components and cystic components is also observed on ultrasonography (5). A low signal intensity on T1-weighted images and a high signal intensity on T2-weighted images are often observed on MRI, whereas tumors are usually contrasted gradually on T1-weighted images of gadolinium ethoxybenzyl diethylenetriamine pentaacetic acid contrast-enhanced MRI (7). However, these imaging findings can also be observed in other pancreatic tumors and are not diagnostic for pancreatic schwannomas. In particular, findings showing a mixture of solid components and cystic components in a mass with smooth margins can also be seen in SPNs, pancreatic neuroendocrine tumors with cystic changes, and pancreatic epithelial cysts. Therefore, it is difficult to make a diagnosis of pancreatic schwannoma solely based on imaging findings.

In the present case, an anechoic area suspected of being a cystic change was observed to have formed during a short observation period. Furthermore, varying imaging findings were observed on EUS at our hospital; for example, there was a morphological change from unilocular to bilocular type. This may have been because the previously mentioned Antoni A and B areas were both present in a complex manner within the mass. Therefore, consistent with previous studies, we also had difficulty making an imaging-based diagnosis. However, we managed to make a pathological diagnosis of pancreatic schwannoma based on the EUS-FNA findings.

Despite the small size of the tumor in the present case, EUS-FNA allowed for a pathological diagnosis. We searched PubMed for cases of schwannomas of up to 20 mm and found only 17 cases [Table 2 (8-23)]. The mean age of the 18 patients, including the present case, was 59.4 years old. Of these patients, 7 were men, and 11 were women. Seven patients exhibited symptoms. In particular, the tumor was in the pancreatic head in three patients, pancreatic head and body in two patients, pancreatic neck in one patient, pancreatic body in nine patients, pancreatic tail in one patient, and uncinate process in two patients. None of these patients were diagnosed with schwannoma based on imaging findings. The differential diagnoses were varied and included serous cystic neoplasm, SPN, neuroendocrine tumor, and in-

traductal papillary mucinous neoplasm. Among these 18 patients, 12 underwent EUS-FNA, of whom 9 were diagnosed with schwannoma. Observation was conducted in 7 patients, and surgery was performed in 11 patients. Even when patients had small tumors, diagnostic surgery was performed for the majority, which differs from our management. Observation was conducted in seven of nine patients who were pathologically diagnosed through EUS-FNA, including our patient. All seven cases of pancreatic schwannoma diagnosed by EUS-FNA without surgical resection showed positive staining for S-100 protein. EUS-FNA was performed using a 25-gauge needle in four patients and a 22-gauge needle in three patients. A biopsy needle was used in three patients.

According to Bruno et al. (21), the diagnostic rate of pancreatic schwannoma through EUS-FNA is 52.9%, which is lower than that of other pancreatic tumors. However, studies have found that using the recently developed Franseen needle enables the collection of more tissue than existing puncture needles (24, 25). Changing the needle type may help improve the diagnostic rate of small tumors, such as that in the present case. EUS-FNA is useful for making a pathological diagnosis of small pancreatic tumors, which can facilitate the observation and selection of minimally invasive surgery. Therefore, we recommend EUS-FNA for pancreatic tumors with nonspecific imaging findings that may be pancreatic schwannomas, such as the present case.

As the present patient had a small, asymptomatic tumor with a low MIB-1 labeling index, the lesion was followed up without surgical resection. If the tumor grows, it may compress the pancreatic duct, and if it develops into a large tumor, it may be found to be a malignant schwannoma (26). Therefore, careful monitoring is required.

In summary, we herein report the first English publication of pancreatic schwannoma diagnosed using EUS-FNA with a Franseen needle and immunohistochemistry without surgical resection. A definitive diagnosis is often made after surgery is performed. However, it is possible to avoid major surgery if the pathological diagnosis is made preoperatively. In recent years, the accuracy of EUS-FNA-based diagnoses of pancreatic tumors has improved. Consequently, the proactive use of EUS-FNA for nonspecific pancreatic tumors is recommended.

The authors state that they have no Conflict of Interest (COI).

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