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Solitary Fibrous Tumors of the Pleura of the Thorax: CT and FDG PET Characteristics in a Tertiary Referral Center

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Abstract: This study was conducted to describe the characteristics of a solitary fibrous tumor of the pleura (SFTP) on chest CT, and FDG PET. Furthermore, we analyze the prognosis of SFTP using large data confirmed in a tertiary referral hospital.

From January 1997 to March 2012, 41 patients (21 males and 20 females; median age: 59 yr; age range: 27–85 yr) who were pathologically diagnosed with SFTP were consecutively examined. The CT findings, including the size, shape, homogeneity, and anatomic location (chest wall, intrapulmonary/fissure space, diaphragm, and mediastinum) of the SFTP, the ¹⁸F-fluorodeoxyglucose positron emission tomography (FDG PET) findings, and the histopathology findings were evaluated.

Most of the patients had a mass-type (70.7%), oval/elliptical (80.5%), and homogeneous (70.7%) SFTP with a median diameter of 6.0 cm (range: 1–17). The most common anatomic location was the chest wall (43.9%), followed by the intrapulmonary/fissure space (22.0%), diaphragm (22.0%), and mediastinum (12.3%). For all the 9 patients, the mean maxSUV was 2.9 (SD = 1.16; range: 1.2–4.9) on FDG PET. The malignant SFTP (median: 3.6, range: 2.5–4.9) showed more hypermetabolic than benign SFTP (median: 2.0, range: 1.2–3.1) ($P = 0.049$).

Through familiarity with the various features of the SFTP with regard to its size and location on the preoperative CT and FDG PET, we can add this rare pleural neoplasm to the differential diagnosis of other more common conditions. Moreover, an appropriate treatment choice can be made.

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Abbreviations: CT = computed tomography, FDG PET = ¹⁸F-fluorodeoxyglucose positron emission tomography, maxSUV = mean maximum standardized uptake value, SFTP = solitary fibrous tumor of the pleura.

INTRODUCTION

A solitary fibrous tumor of the pleura (SFTP) is a mesenchymal neoplasm that originates from the visceral pleura of the chest wall. It can be benign or malignant. It is rare,

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accounting for less than 5% of all pleural neoplasms. It most commonly occurs in the fifth or sixth decade of life, and has no significant sex predilection. Although approximately half of SFTP patients are asymptomatic, cough, chest pain, and dyspnea may be presented, especially in patients with relatively large tumors.^{1,2}

Histologically, the most common architectural pattern is the so-called “patternless pattern,” in which spindle cells with bland ovoid vesicular nuclei, scarce cytoplasm, and connective tissue are arranged in a random pattern characterized by a combination of alternating hypocellular and hypercellular areas.^{3,4} In the histologic criteria published by England et al,³ a solitary fibrous tumor of the pleura (SFTP) is classified as malignant when 1 or more of the following criteria are met: a mitotic count of more than 4 mitosis per 10 high-power fields (HPF); presence of necrosis; presence of nuclear atypia; and hypercellularity.

It has been reported that a SFTP usually appears as a homogeneous, well-defined soft-tissue mass abutting the pleural surface adjacent to the chest wall, with an obtuse angle, on CT. However, the number of cases in each study is small, and clinical-practice limitations in the diagnosis of a SFTP using pre-operative imaging modalities based on these studies are still being encountered.^{2,5,6} The diagnostic accuracy of a CT has not been high until now because the imaging findings of a SFTP are very diverse depending on its size and location; the chest wall, intrapulmonary/fissure space, diaphragm, or mediastinum.

This study was conducted to describe the characteristics of a solitary fibrous tumor of the pleura (SFTP) on chest CT, and FDG PET as opposed to its major differential diagnosis, according to its location, based on the large data confirmed in a tertiary referral hospital.

METHODS

Patient Characteristics

This retrospective study was approved by the Institutional Review Board of the authors' hospital (IRB reference number 2013–1096). The informed consent was waived. Between January 1997 and March 2012, a total of 41 consecutive patients were included in the study.

The CT findings used within 30 days of the tissue confirmation were included in this study.

The clinical presentations reflected in the electronic medical records were reviewed. The underlying combined systemic malignancy other than a SFTP was investigated (Table 1), and the disease-specific survival rate was reviewed during outpatient's follow-up.

Diagnosis of Solitary Fibrous Tumor of the Pleura

Tissue Confirmation Using the Surgical Method

Thirty-three patients (80.5%) were finally confirmed to have had a SFTP through surgery. Among them, percutaneous

TABLE 1. Baseline Characteristics of the 41 Study Populations With Solitary Fibrous Tumor of the Pleura

	Total SFTP N = 41 (%)	Benign SFTP N = 35	Malignant SFTP N = 6	P Value
Age (y), median (range)	59 (27–85)	58 (27–85)	64 (47–80)	0.427
Sex (male)	21 (51.2)	18 (51.4)	3 (50.0)	0.948
Sex (female)	20 (48.8)	17 (48.6)	3 (50.0)	
Smoking habit				
Current smoker	7 (17.1)	7 (20.0)	0	N/A
Past smoker	11 (26.8)	10 (28.6)	1 (16.7)	
Never smoked	23 (56.1)	18 (51.4)	5 (83.3)	
Pack years (mean)	11.5	7.5	4	0.222
Combined malignancy*	6 (14.6)	3 (8.6)	3 (50.0)	0.148
Symptoms				N/A
Incidental	33 (80.5)	29 (82.9)	4 (66.7)	
Cough	5 (12.2)	5 (14.3)	0	
Chest pain	2 (4.9)	1 (2.9)	1 (16.7)	
Others	1 (2.4)	0	1 (16.7)	
Preoperative work-up, n				0.070
CT image only	32 (78.0)	31 (88.6)	1 (16.7)	
CT+FDG PET image	9 (22.0)	4 (11.4)	5 (83.3)	
Tissue confirmation				0.323
Operation after biopsy	21 (51.2)	16 (45.7)	5 (83.3)	
Operation only	12 (29.3)	11 (31.4)	1 (16.7)	
Segmentectomy	29 (87.9)	27 (77.1)	2 (33.3)	
Lobectomy	2 (6.0)	0	2 (33.3)	
Bilobectomy	1 (3.0)	0	1 (16.7)	
Pneumonectomy	1 (3.0)	0	1 (16.7)	
Core biopsy only	8 (19.5)	8 (22.9)	0	
Long-term follow-up				
Recurrence		0	2 (33.3)	
Metastasis		0	3 (50.0)	
NED		35 (100.0)	1 (16.7)	

The values are expressed as median (range) or frequency (%).

CT = computed tomography, FDG PET = ¹⁸F-fluorodeoxyglucose positron emission tomography CT, MRI = magnetic resonance imaging, NED = no evidence of disease after operation. No one expired due to SFTP.

* Combined malignancy was revealed as lung cancer, hepatocellular carcinoma, gastrointestinal stromal tumor in 3 benign SFTP and as thyroid cancer, colon cancer, renal cell carcinoma in 3 malignant SFTP.

core needle biopsy was performed on 21 patients before their operation. They had undergone additional surgery due to the following causes: malignancy was suggested in the needle biopsy in 3 patients; the result of the needle biopsy had low diagnostic certainty in 6 patients (e.g., in the patient of the spindle cell neoplasm); the pathologic report was discordant with the radiologic findings in 9 patients (e.g., of a benign SFTP in the biopsy in an aggressive-looking large mass on the CT); and there was a pathologic-radiologic concordant benign mass in 3 patients based on the clinicians' decision. Among the 33 patients, segmentectomy was most commonly performed on 29 patients (Table 1). Twelve patients underwent surgical excision biopsy because of a small, benign-looking lesion on their CT image that looked easily resectable by a radiologist, thoracic oncologist, and thoracic surgeon without prior tissue confirmation, via video-assisted thoracic surgery using a multidisciplinary approach.

Tissue Confirmation Through Needle Biopsy

Among the total of 41 patients in this study, 8 patients (19.5%) were diagnosed only through percutaneous core needle

biopsy. 18- or 20-gauge semiautomatic core biopsy needle (Stericut with a coaxial guide, TSK Stericut, TSK Laboratory, Soja, Japan) was used for these procedure. A 1 to 3-time biopsy was performed with the patient's breath held during each procedure, to obtain adequate samples for diagnosis.

CT Evaluation

CT Scanning Protocol

The SOMATOM (Siemens Medical Solutions, Forchheim, Germany) (33 patients) and Lightspeed VCT (volume-computed tomography) (General Electric Medical Systems, Milwaukee, WI) (8 patients) are the most representative CT. The scan parameters of SOMATOM scanner were 120 kV peak and 100 effective mA with dose modulation. The reconstruction interval used for the B50 algorithm was 5 mm without gaps, and for the B60 algorithm was 1 mm with a 5 mm gap. The scan parameters of General Electric CT scanner were 120 kV peak and 100–300 effective mA with dose modulation. The reconstruction interval used for the lung algorithm was 5 mm without gaps, and for the bone algorithm was 1.25 mm with a 5 mm gap.

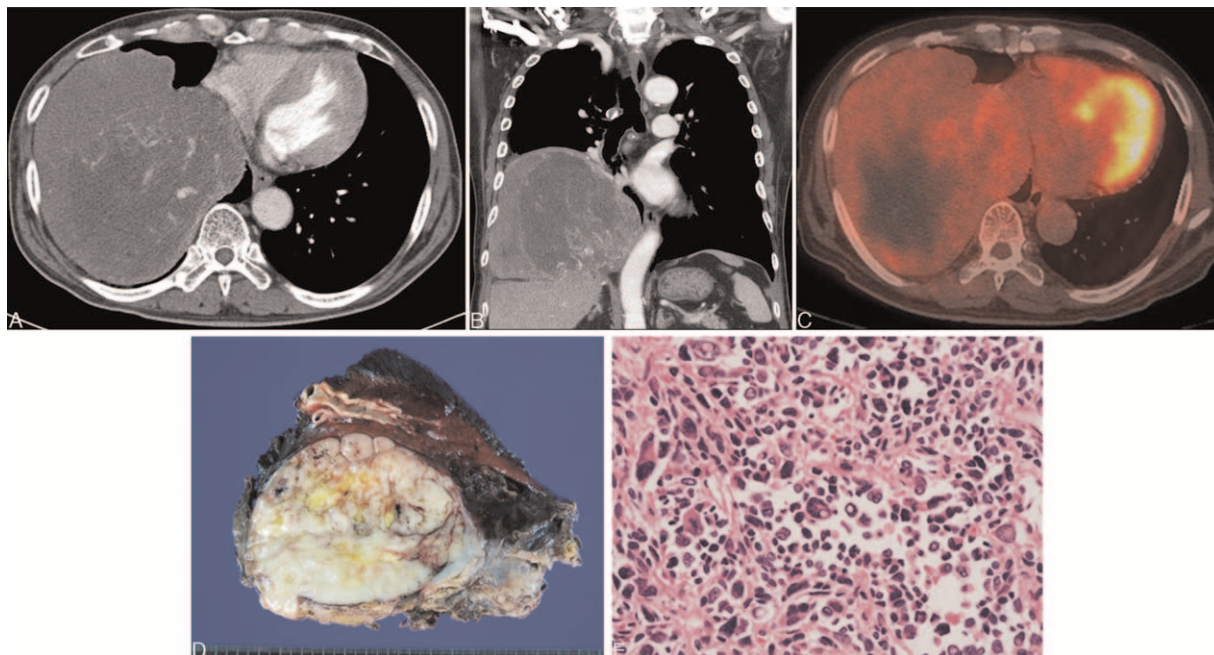


FIGURE 1. A 74-year-old man with malignant solitary fibrous tumor of the pleura with malignant characteristics, who presented a gradually enlarged pleural mass and subsequent brain metastasis. A and B, Enhanced chest CT transverse and coronal images of the mediastinal window at the right and left atrium levels, respectively, showing a bulky, lobulated, heterogeneously enhancing mass involving the right hemi-diaphragm, displacing the heart and right lower lobe, and mimicking sarcoma. Not an indistinct fat plan of the diaphragm and liver dome. C, Whole-body ¹⁸F-fluorodeoxyglucose positron emission tomography CT transverse image showing mild hypermetabolism (maxSUV: 3.3). D, The patient had undergone pleural mass excision and right lower lobectomy. The mass did not involve lung parenchyma but the diaphragm. Photograph of a tumor showing a lobulating margin. E, Photomicrograph of the histologic specimen showing a 23/10 high-power-field mitosis and no lymphovascular invasion. Note the nuclear pleomorphism, which may also characterize a malignant fibrous tumor of the pleura (hematoxylin and eosin stain, ×200).

The range of chest CT scan was between the supraclavicular area and the level of the adrenal glands. All the images were viewed on the mediastinal (width, 450 HU; level, 50 HU) and lung window (width, 1500 HU; level, -700 HU) settings of the axial and coronal images on the picture archiving and communication system (PACS).

CT Evaluation

Two radiologists (MYK, 18 years’ experience in thoracic radiology; and HJL, 5 years’ experience in thoracic radiology) evaluated the CT images finally in consensus. They were blinded to the clinical data, except to the fact that all the patients had a SFTP. Using the CT scans of the 41 patients in this study, the following were described: the size (the longest diameter on axial image); the type of nodule (≤3 cm) (Figure 2) or mass (>3 cm) (Figure 1); 2 tumor shapes: oval/elliptical and round (Figure 2); 2 homogeneities: homogeneous or heterogeneous (Figure 1); and 4 anatomic locations according to the broad base of the mass (more than 100°): the chest wall, intrapulmonary/fissure space defined as enveloped by the lung parenchyma (Figure 2), diaphragm (Figure 1), and mediastinum (Figures 3 and 4).

The diagnostic accuracy was evaluated either as the “top or bottom differential diagnosis” or as a “missed diagnosis” in the formal CT report before the tissue confirmation, respectively. The correct diagnosis was regarded as the “top differential diagnosis.” “Missed diagnosis” means SFTP was not included as a differential diagnosis.



FIGURE 2. A 71-year-old woman with a benign solitary fibrous tumor of the pleura manifesting as a nonspecific solitary pulmonary nodule. The enhanced chest CT transverse image of the mediastinal window at the basal segmental pulmonary arteries shows a 1.3 × 1.0 cm nonspecific solitary pulmonary nodule in the right middle lobe with a smooth margin and homogenous attenuation. On the follow-up CT after a year, the nodule showed interval growth with a 1.5 × 1.2 cm size and with the same CT characteristics (not shown). The whole-body ¹⁸F-fluorodeoxyglucose positron emission tomography CT transverse image shows mild hypermetabolism (maxSUV: 1.8) (not shown).

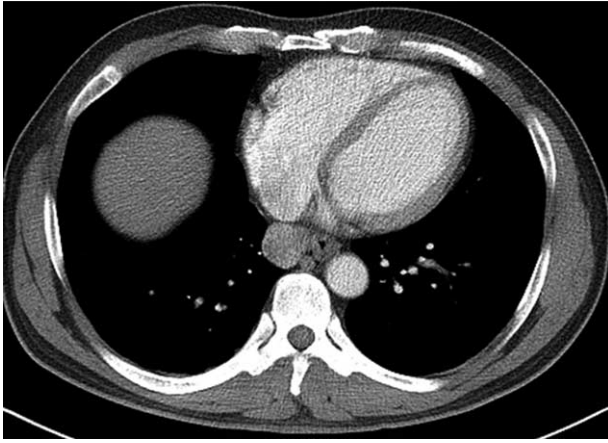


FIGURE 3. A 51-year-old man with a benign solitary fibrous tumor of the pleura manifesting as a mediastinal tumor. This patient had underlying hepatocellular carcinoma. The enhanced chest CT transverse at the diaphragm level image of the mediastinal window shows a 2.8 cm paraesophageal mass with a smooth margin and heterogeneous attenuation in the posterior mediastinum, mimicking metastatic lymphadenopathy or a neurogenic tumor. The whole-body ^{18}F -fluorodeoxyglucose positron emission tomography CT transverse image shows no hypermetabolism in the tumor (not shown).

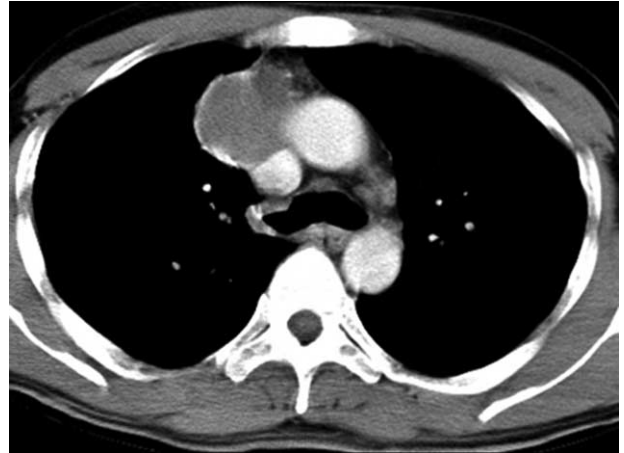


FIGURE 4. A 47-year-old man with a malignant solitary fibrous tumor of the pleura manifesting as a mediastinal tumor. The patient had a history of hemangiopericytoma and expired due to respiratory failure. The enhanced chest CT transverse image at the SVC-level mediastinal window shows a 4 cm oval mass with a smooth margin and homogeneous attenuation in the anterior mediastinum, mimicking metastatic lymphadenopathy or other mediastinal tumors.

FDG PET/CT Evaluation

PET/CT scanner (Discovery PET/CT 690; GE Health Care, Milwaukee, Wis, USA) was used for ^{18}F -fluorodeoxyglucose positron emission tomography (FDG PET). The patient fasted for at least 6 hours. After the ^{18}F -FDG (for a 5.2MBq/kg body weight) injection intravenously, PET/CT scanning was obtained after 50 minutes. The reconstruction of images was obtained using a 3-dimensional (3D) ordered subset expectation maximization (OS-EM) algorithm. The CT attenuation maps were used for attenuation corrections. The lean body mass-based standardized uptake value (SUV) was calculated. The maximum SUV (maxSUV) of a SFTP on the FDG PET in 9 patients was described. A maxSUV value of 2.5 was used as the cut-off value between the benign (hypometabolic) and malignant (hypermetabolic) tumors. The mean interval between the PET and CT studies was 8 days (range: 1–19).

Statistical Analysis

For the statistical analysis, a commercial statistical package (SPSS version 12.0, SPSS Inc, Chicago, IL) was used by a statistician with 10 years of experience (SSK). The results were expressed as medians within a range or as mean \pm SD. A P value less than 0.05 was regarded as indicative of statistical significance. The size values and the maxSUV of masses diagnosed as between benign SFTP and malignant SFTP were compared using the Mann–Whitney U test.

RESULTS

Patients' Characteristics

The study subjects consisted of 20 women and 21 men with ages ranging from 27 to 85 years (median: 59). Most of the SFTPs ($n = 33$, 80.5%) were incidentally found on the screening CT and had no patient symptom. Cough ($n = 5$, 12.2%) and

chest pain ($n = 2$, 4.9%) were the most frequent symptoms. One patient was transferred from a local hospital due to a recurrent tumor.

Thirty-five patients had a benign SFTP, and 6 patients had a malignant SFTP. The relative prevalence of malignancy was 14.6%.

The malignant SFTPs showed locally invasive properties or relapse following surgical resection. In this study, except for 1 patient, all the patients had recurrent tumors or metastases ($n = 5$, 83.3%). The patients' outcomes with regard to their malignancies are described in Table 3. For benign SFTPs, disease-related morbidity or mortality was absent.

Half of the patients with a malignant SFTP had an underlying malignancy ($n = 3/6$, 50.0%), whereas only a small proportion of those with a benign SFTP did ($n = 3$, 8.6%). An underlying malignancy means the patient had a previously diagnosed, intra- or extra-thoracic malignant disease. The baseline characteristics of the study population are summarized in Table 1.

The disease-specific survival rate of the benign SFTPs was 100% up to the latest outpatient's follow-up. No one expired due to a benign SFTP (Table 1).

CT Evaluation

The median SFTP size was 6.0 cm (wide range: 1–17 cm). Masses ($n = 29$, 70.7%) were more common than nodules ($n = 12$, 29.3%). There was no statistically significant difference between the benign and malignant SFTPs in terms of size ($P = 0.183$).

The most common tumor shape was ovoid or elliptical (80.5%), with a smooth margin. Regarding the homogeneity, small SFTPs were mostly homogenous (Figure 2), and large SFTPs were mostly heterogeneous (Figure 1).

Regarding the anatomical location, the most common was the chest wall ($n = 18$, 43.9%). At this location, SFTP was the

TABLE 2. CT and FDG PET Findings of the 41 Study Populations With Solitary Fibrous Tumor of the Pleura

CT and FDG PET Findings	Total (N = 41)		Benign SFTP (N = 35)		Malignant SFTP (N = 6)		p-value
	N, Median	%, (Range)	N, Median	%, (Range)	N, Median	%, (Range)	
Size on transverse scan, cm	6	(1–17)	5.4	(1–14)	9.7	(4–17)	0.183
Type							
Nodule (≤3 cm)	12	29.3	12	34.3	0	0.0	N/A
Mass (>3 cm)	29	70.7	23	65.7	6	100.0	
Shape							
Round	8	19.5	7	20.0	1	16.7	N/A
Oval/elliptical	33	80.5	28	80.0	5	83.3	
Homogeneity							
Homogeneous	29	70.7	28	80.0	1	16.7	N/A
Heterogeneous	12	29.3	7	20.0	5	83.3	
Anatomic location							
Chest wall	18	43.9	17	48.6	1	16.7	N/A
Intrapulmonary/fissure space	9	22.0	8	22.9	1	16.7	
Diaphragm	9	22.0	6	17.1	3	50.0	
Mediastinum	5	12.3	4	11.4	1	16.7	
Max SUV Mean ± SD (range)	9	2.9 ± 1.16 (1.2–4.9)	4	2.0 ± 0.85 (1.2–3.1)	5	3.6 ± 1.1 (2.5–4.9)	0.049

Values are expressed as medians (range) or frequencies (%).

FDG PET = ¹⁸F-fluorodeoxyglucose positron emission tomography CT, maxSUV = maximum standardized uptake value.

top differential diagnosis in 12 patients (66.7%). The second common location was the intrapulmonary/fissure space (n = 9) or diaphragm (n = 9). Especially in small SFTPs, a close relationship to the pleura/fissure was shown (Figure 3), with an occasionally intrapulmonary location (Figure 2). In those patients, missed diagnoses commonly occurred (n = 5), and the most probable radiologic diagnosis was a solitary pulmonary nodule, such as sclerosing hemangioma (n = 5) or lung cancer (n = 3). Close abutment of the diaphragm (n = 9) was shown in the larger SFTPs (Figure 1). A missed diagnosis occurred in only 1 patient (11.1%), and the top differential diagnosis was sarcoma (n = 4). The least common location was the mediastinum (n = 5) (Figures 3 and 4). A missed diagnosis occurred in 2 patients (40.0%), and the top differential diagnosis was lymphoma (n = 2). Overall, the “top differential diagnosis” was correct in 23 of 41 patients (56.1%), and there was a misdiagnosis in 10 of 41 patients (24.3%) (Table 4).

FDG PET Evaluation

For all the 9 patients, the mean maxSUV was 2.9 (SD = 1.16; range: 1.2–4.9). For the 4 patients with a benign SFTP, the mean max SUV was 2.0 (SD = 0.85; range: 1.2–3.1), and for the 5 patients with a malignant SFTP, the mean max SUV was 3.6 (SD = 1.1; range: 2.5–4.9). There was a statistically significant difference between the max SUVs of the benign and malignant SFTPs (P = 0.049) (Tables 2 and 3).

DISCUSSION

The clinical manifestations of an SFTP in this study are similar to those in the previous studies.^{1,2} The prevalence of malignancy seen at the authors’ medical institute was 14.6% in a single ethnic study, whereas the previously reported incidence of a malignant SFTP varied from 12 to 37%.^{4,7–10}

Initially, the tumors show a wide range of sizes (1–17 cm in diameter) in a variable location, and show variable radiologic

findings according to size, as demonstrated in a previous study.² Due to the variable atypical radiologic findings of a SFTP, the diagnostic accuracy of the pre-operative CT is usually not very high. The diagnostic accuracy of the top differential diagnosis was approximately half (56.1%) in our study. A missed diagnosis occurred in 24.3% of the study subjects. This means in approximately one-fourth of all the cases in this study, SFTP was not considered a differential diagnosis at all.

The cases of a “typical SFTP” demonstrated a homogeneous, well-defined, noninvasive, soft-tissue mass abutting the chest wall and with an obtuse angle, as seen through CT imaging.² In these typical cases, using a correct diagnostic approach is not that difficult. The atypical radiologic features of a SFTP are dependent on the tumor size and location.

In this study, the chest wall was the most common location, and the percentage of correct diagnoses was relatively high,

TABLE 3. Detailed FDG PET Findings of the 9 Localized Fibrous Tumor of the Pleura

Pathology	Age/Sex	Size (cm)	maxSUV on FDG PET
Malignant (n = 5)	77/M	17	3.3
	52/M	8	4.9
	67/F	13	2.3
	61/F	8	3
	80/F	8	4.4
Benign (n = 4)	44/F	2.4	1.2
	59/M	14	1.8
	75/M	1.5	1.8
	68/F	4.3	3.1

FDG PET = ¹⁸F-fluorodeoxyglucose positron emission tomography CT, maxSUV = maximum standardized uptake value.

TABLE 4. Diagnostic Accuracy and Common Confusing Disease of the Solitary fibrous Tumor of the Pleura by location in the Formal CT Report

Location	N (%)	Top Differential Diagnosis N (%)	Bottom Differential Diagnosis N (%)	Missed Diagnosis N (%)	Most Common Confusion, N
Chest wall	18 (43.9)	12/18 (66.7)	4/18 (22.2)	2 /18 (11.1)	Neurogenic tumor, 5
Intrapulmonary/fissure space	9 (22.0)	3/9 (33.3)	1/9 (11.1)	5 /9 (55.6)	Sclerosing hemangioma, 5 (lung cancer, 3)
Diaphragm	9 (22.0)	6 /9 (66.7)	2/9 (22.2)	1 /9 (11.1)	Sarcoma, 4
Mediastinum	5 (12.2)	2/5 (40.0)	1/5 (20.0)	2 /5 (40.0)	Lymphoma,2
Total	41 (100)	23/41 (56.1)	8/41 (19.5)	10/41 (24.3)	

Top and bottom differential diagnosis included as a differential diagnosis in the formal CT report before tissue confirm.

Misdiagnosis means that SFTP is not included as a differential diagnosis in the formal CT report.

Most common confusion means that the disease is most commonly in differential diagnosis regardless diagnostic accuracy.

especially with regard to the small tumors. However, the SFTP may sometimes appear indistinguishable from a neurogenic tumor, in which case it is important to evaluate the adjacent ribs. Chest wall involvement in a SFTP is rare, though, and sclerosis or cortical erosion of the ribs is a more typical feature of neurogenic tumors.¹¹ When a small SFTP is located within the intrapulmonary/fissure space, the diagnostic accuracy is poor. It may also be misinterpreted as a pulmonary nodule, especially when it appears to be totally surrounded by pulmonary parenchyma. In such a case, a missed diagnosis commonly occurs, and the common differential diagnosis is a solitary pulmonary nodule, such as sclerosing hemangioma or lung cancer.

When a tumor is located in the anterior mediastinum, it can mimic a common anterior mediastinal tumor such as thymoma or lymphoma. In those cases, even awareness of the pleural origin is not that easy, and the diagnostic accuracy is relatively poor. In fact, in lesions with a pleural origin, the mediastinum is compressed and dislocated, contrary to what occurs in the presence of a mediastinal mass that expands, thus compressing the pulmonary parenchyma without causing mediastinal shift.^{5,7,11–13} When a tumor is too small to have a mass effect, however, the aforementioned clues are difficult to identify. Other possible differential diagnoses in this location are solitary lymphadenopathy and a bronchogenic cyst. Bronchogenic cysts can show high attenuation but no solid contrast enhancement.

When a large tumor is abutting the diaphragm, the diagnostic accuracy is relatively good. It usually mimics sarcoma or peripheral lung cancer, especially in a malignant SFTP.

Additionally, regardless of the size and location of a tumor, if it coexists with other indeterminate lung nodules or if the patient has another underlying malignancy, differential diagnosis between primary lung cancer and metastasis with a SFTP is difficult.

Larger lesions, irrespective of their pathology, are typically heterogeneous and may not exhibit CT features suggestive of a pleural tumor. Such a heterogeneous enhancing pattern has been shown to be correlated with myxoid changes and areas of hemorrhage, necrosis, cystic degeneration, or enhanced vessels within the mass.^{2,7,14} In these cases, both benign and malignant SFTPs can mimic other malignancies, such as sarcomas or peripheral lung cancer. According to the previous studies, the tumor size is not necessarily correlated with a malignant potential, although larger tumors have been noted to tend to be malignant.^{7,15} In this study, the malignant SFTPs tended to be larger than the benign SFTPs, although there is generally no

known size difference between benign and malignant SFTPs. However, none of the malignant SFTPs in this study appeared as a nodule (<3 cm), whereas 66% of the benign SFTPs did. Based on this, when a tumor has a large axial diameter of more than 3–4 cm and is a mass rather than a nodule, clinicians should consider the possibility of malignancy, and should recommend surgery in addition to needle biopsy.

FDG PET is useful for diagnosing malignant pleural diseases, although the utility of FDG PET for evaluating the extent and nodal metastasis is still controversial.¹⁶ Furthermore, the standard uptake values in differentiating benign from malignant diseases are controversial.^{17,18} Recent report shows a high cellularity of an SFTP may be a cause of increased FDG uptake, regardless of the pathologic malignancy.¹⁹ In this study, the mean maxSUV of the five malignant SFTPs was higher than that of the four benign SFTPs. However, the relatively low maxSUVs of the malignant SFTP were strong differentiating points from the metastasis of other malignancies, such as primary lung cancer or sarcoma in the thorax. Based on these, FDG PET can be a valuable addition to the diagnostic tools of SFTP for its differential diagnosis from other malignant conditions. Cardillo et al¹² showed in their study the high negative predictive value of FDG PET scanning in assessing the malignancy of such lesions.

This study had some limitations. First, the number of patients included in the study was small, and the study was a single tertiary referral hospital, consecutive study. Second, the 8 patients with benign SFTP were histopathologically diagnosed through percutaneous core needle biopsy only. In tumors with an axial diameter larger than 4 cm, such core needle biopsy is not definitive enough. Finally, the number of FDG PET studies conducted was relatively small compared with the number of CT studies conducted. For SFTP, we usually do not perform PEG PET routinely, especially in benign and small resectable cases.

A strategic approach that uses multiple modalities is needed for SFTP diagnosis due to the presence of diverse manifestations, from a tiny nodule to a huge mass, in various anatomic locations of the thorax. Future studies on FDG PET for the comprehensive understanding of benign and malignant SFTPs using a combination of modalities are needed. There have been many studies on radiologic findings of SFTP, but accurate diagnosis in routine radiologic practice is still difficult due to the variable locations and the diverse spectra shown with regard to the sizes of the tumors.

In conclusion, through familiarity with the various features of SFTPs with regard to their size and location on a preoperative CT and FDG PET, we found that we can add this rare pleural neoplasm to the differential diagnosis of other more common conditions, and that an appropriate treatment choice can be made.

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