Validation of a Scoring System to Predict Recurrence of Resected Solitary Fibrous Tumors of the Pleura

Luis F. Tapias, MD; Olaf Mercier, MD, PhD; Maria R. Ghigna, MD; Benoit Lahon, MD; Hang Lee, PhD; Douglas J. Mathisen, MD, FCCP; Philippe Dartevelle, MD; and Michael Lanuti, MD, FCCP

BACKGROUND: Solitary fibrous tumors of the pleura (SFTPs) are infrequent neoplasms with no standardized criteria to predict risk of recurrence after curative surgery. The aim of the present study is to validate a recently proposed recurrence score in a large European cohort of patients with SFTP.

METHODS: Validation of a previously published scoring system was assessed in a population of 113 patients who underwent complete resection of SFTPs. Patients were scored according to the pleural origin, morphology, size, hypercellularity, presence of necrosis or hemorrhage, and number of mitoses in their SFTPs. Receiver operating characteristic curves were plotted for the score. Time to recurrence analysis was performed using the Kaplan-Meier and Cox proportional hazards methods.

RESULTS: After a mean follow-up of 13.2 ± 7.3 years, there were nine recurrences (8.0%). Score performance to predict recurrence was as follows: sensitivity = 78%, specificity = 74%, positive likelihood ratio = 3.0, and negative likelihood ratio = 0.3. A cutoff of 3 points was used to classify 79 patients (69.9%) at low risk and 34 patients (30.1%) at high risk for recurrence. A high-risk classification was significantly associated with more recurrences during follow-up ($P = .004$), worse overall survival ($P = .0008$), more extensive lung resections ($P = .001$), and the use of adjuvant therapies ($P = .009$). The present score outperformed England's criteria ($P = .049$) and de Perrot classification ($P < .001$) when predicting SFTP recurrence.

CONCLUSIONS: The proposed scoring system, which combines common clinical and histologic features of resected SFTPs, remains predictive of recurrence in a separate patient population. The simple score may guide the postoperative surveillance of this uncommon tumor.

CHEST 2015; 147(1):216-223

Manuscript received May 15, 2014; revision accepted July 15, 2014; originally published Online First August 7, 2014.

ABBREVIATIONS: HPF = high-power field; HR = hazard ratio; ROC = receiver operating characteristic; SFTP = solitary fibrous tumor of the pleura

AFFILIATIONS: From the Division of Thoracic Surgery (Drs Tapias, Mathisen, and Lanuti), and the Biostatistics Center (Dr Lee), Massachusetts General Hospital, Boston, MA; and the Department of Thoracic and Vascular Surgery and Heart-Lung Transplantation (Drs Mercier, Ghigna, Lahon, and Dartevelle), Marie Lannelongue Hospital, Paris, France.

FUNDING/SUPPORT: The statistical analysis of this work was conducted with support from Harvard Catalyst: The Harvard Clinical and

Translational Science Center, National Center for Research Resources, and the National Center for Advancing Translational Sciences, National Institutes of Health [Award 8UL1TR000170-05], and financial contributions from Harvard University and its affiliated academic health-care centers.

CORRESPONDENCE TO: Michael Lanuti, MD, FCCP, Division of Thoracic Surgery, Massachusetts General Hospital, 55 Fruit St, Blake 1570, Boston, MA 02114; e-mail: mlanuti@mgh.harvard.edu

© 2015 AMERICAN COLLEGE OF CHEST PHYSICIANS. Reproduction of this article is prohibited without written permission from the American College of Chest Physicians. See online for more details.

DOI: 10.1378/chest.14-1180

Solitary fibrous tumors of the pleura (SFTPs) are rare intrathoracic neoplasms that exhibit a benign behavior in the majority of cases. Symptoms are directly related to the mass effect within the thoracic cavity and, on rare occasion, to paraneoplastic syndromes causing hypoglycemia and digital clubbing.¹ Surgical resection is the treatment of choice for most patients, achieving high cure rates.²⁻⁷ However, approximately 10% to 15% of patients experience SFTP recurrence after surgery,²⁻⁷ which in some cases can lead to death. In a landmark study, England et al⁸ recognized SFTP characteristics that were associated with malignant behavior after analyzing the largest sample of SFTPs ever published. Despite these criteria, published surgical series have failed to use standardized criteria to classify SFTPs as “malignant.”²⁻⁷ To classify patients with SFTP according to their risk of recurrence is relevant, as this would result in more appropriate post-operative surveillance protocols and may identify patients who would benefit from adjuvant therapies. Currently, surveillance after surgery is guided by recommendations from experts stating that radiologic examination should be performed at least yearly in all patients.^{1,9}

Materials and Methods

Patients

There were 157 patients with SFTPs during the study period. Exclusion criteria included metastatic disease ($n = 2$), multifocal disease ($n = 12$), inoperability because of medical comorbidities ($n = 3$), incomplete resections ($n = 7$), and unavailable medical records ($n = 1$). The remaining patients ($n = 132$) were deemed to have localized and completely resected SFTPs. Of these patients, 15 were excluded because of a lack of complete data for score calculation (eg, incomplete surgical or pathology reports, histology slides not available for review). Another four patients were excluded, as they were lost to follow-up and tumor recurrence status could not be determined. Finally, 113 patients were included in this study for further analysis. Baseline patient characteristics, symptoms at presentation, and details on surgical treatment are shown in Table 1. Approval for this study was obtained from the Institutional Review Boards at the Marie Lannelongue Hospital (IRB# 2014-01-TFSP) and at the Massachusetts General Hospital (IRB# 2010P002097), waiving the need for informed consent.

Scoring System for Recurrence

The present study aims to validate a scoring system developed to predict the risk of recurrence after complete resection of SFTPs. This score was first reported in 2013 after analyzing 59 patients¹⁰ and combines six macroscopic and histopathologic tumor characteristics, as shown in Table 2. In the development cohort, a score ≥ 3 points provided the best performance to predict tumor recurrence with a sensitivity of 100%, specificity of 92%, a positive likelihood ratio of 12.5, and a negative likelihood ratio

A score derived from 59 patients with SFTP treated at a single institution in North America was proposed to assess risk of recurrence.¹⁰ By combining six different tumor characteristics, this score showed the capacity to discriminate patients according to their probability of recurrence, building upon previous studies of SFTP by unifying clinical, surgical, and histologic characteristics. The proposed score is simple and easy to calculate in the clinical setting. For this score to reach clinical application, it needs to be validated in a larger and different population of patients with SFTP.

The aim of the present study is to validate this recurrence score by applying it to the largest cohort of patients with SFTP that has been published since the report by England et al.⁸ Lahon et al⁷ published their experience with 157 patients with SFTP treated at the Marie Lannelongue Hospital in Paris, France. The sensitivity and specificity of the proposed scoring system to predict recurrence after complete resection of SFTP in this patient population is described.

of < 0.0001 .¹⁰ Histologic slides were available for 108 patients (95.6%) and reviewed by a pulmonary pathologist (M. R. G.) specifically for this validation study. For the remaining five patients, score was calculated based on pathology reports. For scoring purposes, tumor size was defined as the longest axis in centimeters; hypercellularity was defined as the presence of regions where tumor cells were crowded, back-to-back, or overlapping and with few or absent interstitial matrices; necrosis or hemorrhage was recorded as present or absent; and the number of mitoses was determined in 10 random high-power fields (HPFs).

Statistical Analysis

Data were analyzed in the statistical software Stata/SE 11 (StataCorp LP). Variables were analyzed as proportions, means, or medians according to their nature. Receiver operating characteristic (ROC) curves were plotted for the scoring system in the current validation cohort and were compared with curves constructed from previously described criteria for malignancy of SFTP, namely the criteria by England et al⁸ (presence of hypercellularity, pleomorphism/atypia, necrosis/hemorrhage, or a mitotic count ≥ 4 mitoses/10 HPF) and the classification by de Perrot et al⁹ (England's criteria plus presence of stalk). Overall survival was defined as the time from surgery to death from any cause. Time to recurrence was defined as the time from surgery to the date of first evidence of tumor recurrence based on medical records. Time-to-event analyses were performed using the Kaplan-Meier and Cox proportional hazards methods. Harrell C-statistic was calculated to assess the predictive power of the multivariate model including all six variables in the score, and its 95% CI was calculated by bootstrapping with 1,000 repetitions. For all comparisons, a P value $< .05$ was considered significant.

Results

Tumor Characteristics and Histopathology

Tumors were determined to arise from the visceral pleura or to be intrapulmonary in 65 patients (57.5%),

whereas they arose from the parietal pleura in 48 patients (42.5%). SFTPs were sessile in 53 patients (46.9%) and pedunculated in 60 patients (53.1%). Median tumor size was 7 cm (interquartile range, 4-14 cm; range, 0.3-30 cm). There were 74 patients (65.5%) with

TABLE 1] Baseline Characteristics, Presenting Symptoms, and Surgical Treatment Among 113 Patients Undergoing R0 Resections of SFTP, France (1980-2010)

Characteristic	Result
Age, y	
Median (IQR)	56 (46-67)
Mean $\pm$ SD	56.3 $\pm$ 13.7
Sex	
Male	55 (48.7)
Female	58 (51.3)
Smoking history	33 (29.2)
Presentation	
Asymptomatic	72 (63.7)
Symptomatic	41 (36.3)
Symptoms ^a	
Cough	20 (17.7)
Chest pain	21 (18.6)
Dyspnea	19 (16.8)
Hemoptysis	2 (1.8)
Paraneoplastic syndromes	
Hypertrophic pulmonary osteoarthropathy	3 (2.7)
Hypoglycemia	2 (1.8)
Normal preoperative PFTs	94 (83.2)
Preoperative tissue diagnosis workup	
Surgical biopsy	3 (2.7)
Needle biopsy	14 (12.4)
Laterality	
Right	58 (51.3)
Left	55 (48.7)
Surgical approach	
Thoracotomy	97 (85.8)
VATS	13 (11.5)
Sternotomy	2 (1.8)
Not recorded	1 (0.9)
Surgical procedures	
Wedge resection, single	80 (70.8)
Wedge resection, multiple	10 (8.9)
Segmentectomy	1 (0.9)
Lobectomy	13 (11.5)
Bilobectomy	3 (2.7)
Pneumonectomy	3 (2.7)
Chest wall resection	6 (5.3)
Isolated	2 (1.8)

(Continued)

TABLE 1] (continued)

Characteristic	Result
+ Lung resection	4 (3.5)
Not recorded	1 (0.9)

Data presented as No. (%) unless otherwise noted. IQR = interquartile range; PFT = pulmonary function test; SFTP = solitary fibrous tumor of the pleura; VATS = video-assisted thoracic surgery.

^aSome patients experienced multiple symptoms.

tumors < 10 cm and 39 patients (34.5%) with tumors $\geq$ 10 cm in longest axis. On review of histology slides, hypercellularity was observed in 44 patients (38.9%), necrosis or hemorrhage was observed in 31 patients (27.4%), and 21 patients (18.6%) had tumors with $\geq$ 4 mitosis/10 HPFs.

Postoperative Follow-up

Postoperative complications were observed in eight patients (7.1%). Eight patients (7.1%) received some type of adjuvant therapy. Two patients (1.8%) received chemotherapy alone, and two (1.8%) received radiation therapy alone; four patients (3.5%) received chemoradiation. Overall survival at 5, 10, and 15 years was 90.1%, 85.5%, and 82.2% for the entire cohort, respectively. After a mean follow-up of 13.2 $\pm$ 7.3 years, tumor recurrence was observed in nine out of 113 patients (8.0%). Detailed data on the site of recurrence were not available. Four patients (44.4%)

TABLE 2] Scoring System for SFTP Recurrence

Tumor Characteristic	Points
Pleural origin	
Visceral/intrapulmonary	0
Parietal	1
Morphology	
Pedunculated	0
Sessile	1
Size (longest axis)	
< 10 cm	0
$\geq$ 10 cm	1
Hypercellularity ^a	1
Presence of necrosis or hemorrhage	1
No. of mitoses (per 10 HPF)	
< 4	0
$\geq$ 4	1

Minimum score = 0, maximum score = 6. HPF = high-power field. See Table 1 legend for expansion of abbreviation.

^aDefined as the presence of regions where tumor cells were crowded, back-to-back, or overlapping and with few or absent interstitial matrices.

experiencing tumor recurrence received adjuvant therapy; three of them received chemoradiation. Although no recurrence was observed in 104 patients, four patients (3.8%) received adjuvant therapy, with only one receiving chemoradiation.

Validation of Recurrence Score

There were nine patients (8.0%) with SFTP recurrence after a mean follow-up of 13.2 ± 7.3 years. Univariate analysis for time to recurrence of the variables included in the score failed to reveal a significant association with parietal pleural origin ($P = .887$) and sessile morphology ($P = .129$), depicted in Table 3. However, a significant association with a higher risk of recurrence was observed with size ≥ 10 cm ($P = .044$), hypercellularity ($P = .014$), necrosis or hemorrhage ($P = .005$), and number of mitoses $\geq 4/10$ HPFs ($P < .001$). On multivariate analysis including all six variables, only the number of mitoses was independently associated with a higher risk of tumor recurrence ($P < .001$). Harrell C-statistic for this multivariate model was 0.914 (95% CI, 0.847-0.982).

TABLE 3] Time to Event Analysis of Factors Associated With Recurrence Included in the Scoring System

Variable	HR (95% CI)	P Value
Pleural origin		.887
Visceral/ intrapulmonary	1.00	
Parietal	1.10 (0.30-4.10)	
Morphology		.129
Pedunculated	1.00	
Sessile	0.30 (0.06-1.42)	
Size (longest axis)		.044
< 10 cm	1.00	
≥ 10 cm	4.17 (1.04-16.67)	
Hypercellularity		.014
No	1.00	
Yes	7.22 (1.49-34.85)	
Presence of necrosis or hemorrhage		.005
No	1.00	
Yes	7.40 (1.85-29.71)	
No. of mitoses (per 10 HPF)		< .001
< 4	1.00	
≥ 4	23.47 (4.84-113.92)	

HR = hazard ratio. See Table 2 legend for expansion of other abbreviation.

Applying the score to this population resulted in the score distribution shown in Table 4. Median score was 2 points (interquartile range, 1-3), and there were no patients with a maximum score of 6 points. The score was significantly associated with time to tumor recurrence per score unit increase (hazard ratio [HR], 2.48; 95% CI, 1.53-4.02; $P < .001$). An ROC curve was plotted as shown in Figure 1, yielding an area under the ROC curve of 0.773 (95% CI, 0.567-0.979). The best discriminatory performance was achieved using a cutoff of 3 points, which was the same found in the score development cohort,¹⁰ resulting in a sensitivity of 78%, specificity of 74%, positive likelihood ratio of 3.0, and negative likelihood ratio of 0.3. Using a cutoff of 3 points, 79 patients (69.9%) were classified at low risk for recurrence, and 34 patients (30.1%) were classified at high risk. Risk of SFTP recurrence was significantly higher in patients classified at high risk when compared with those classified at low risk (HR, 10.28; 95% CI, 2.13-49.55; $P = .004$). Kaplan-Meier SFTP recurrence estimates at 5, 10, and 15 years for patients classified at low risk (< 3 points) were 1.3%, 1.3%, and 3.5%, respectively, whereas for patients classified at high risk (≥ 3 points) they were 13.5%, 17.5%, and 27.9%, respectively ($P = .0003$), as seen in Figure 2. Of 79 patients classified at low risk, only two patients (2.5%) experienced recurrence during follow-up.

Patients classified at high risk experienced worse long-term overall survival. Overall survival estimates at 5, 10, and 15 years for patients classified at low risk for recurrence (< 3 points) were 96.2%, 91.0%, and 89.1%, respectively, whereas for patients classified at high risk (≥ 3 points) they were 75.8%, 72.7%, and 65.5%,

TABLE 4] Recurrence Score Distribution Among Patients With SFTP

Variable, No. (%)	Result
Score, points	
0	8 (7.1)
1	34 (30.1)
2	37 (32.7)
3	16 (14.2)
4	10 (8.9)
5	8 (7.1)
6	0 (0)
Risk classification	
Low risk (< 3 points)	79 (69.9)
High risk (≥ 3 points)	34 (30.1)

See Table 1 legend for expansion of abbreviation.

Area under ROC curve = 0.7730

Figure 1 – ROC curve for the recurrence score. ROC = receiver operating characteristic.

respectively ($P = .0008$). Data on specific causes of death were not available, and therefore cancer-specific survival analyses could not be performed. Patients classified at high risk were more likely to have received adjuvant therapy (17.7% vs 2.5% in low-risk patients, $P = .009$). Lung resections were significantly more extensive in patients classified at high risk. Sublobar vs lobectomy or greater resections were performed in 91.0% and 9.0% of patients classified at low risk, and they were performed in 62.5% and 37.5% of patients classified at high risk, respectively ($P = .001$). Only one low-risk patient (1.3%) required chest wall resection, whereas this was required in five patients (14.7%) classified at high risk ($P = .009$). Also, there was a nonsignificant trend toward higher rates of postoperative complications in high-risk patients (14.7% vs 3.8% in low risk, $P = .052$).

When directly compared with previously published criteria used to determine malignancy of SFTPs, the recurrence score outperformed England's criteria and de Perrot's classification when applied to this population, which had area under the ROC curves of 0.697 (95% CI, 0.545-0.848) and 0.524 (95% CI, 0.373-0.674), respectively, as shown in Figure 3, which were significantly inferior to that obtained with the proposed recurrence score ($P = .049$ and $P < .0001$, respectively).

Discussion

SFTPs are rare neoplasms of mesenchymal origin that are believed to arise from submesothelial connective tissue and were first described in 1931.¹ According to the World Health Organization Histologic Classification

of Soft Tissue Tumors, the behavior of solitary fibrous tumors is unpredictable, although most cases are benign. The infrequent presentation of SFTPs has limited their study to mostly case reports and single-institution case series.²⁻⁷ Since 1989,⁸ factors associated with SFTP malignant behavior have been recognized. However, surgical series have used different criteria to classify tumors as "malignant."²⁻⁷ This lack of uniformity across surgical series makes the extrapolation of results or the pooling of data difficult. Therefore, criteria to identify malignant behavior of SFTPs require standardization.

In the present study, we attempt to validate a recently proposed scoring system for the classification of patients according to their risk of recurrence after complete resection of SFTP.¹⁰ This score was derived after analyzing 59 patients from North America and uses clinically easy-to-obtain information. In the development cohort,¹⁰ this score showed the capacity to discriminate patients who experienced SFTP recurrence from those who did not. By applying this score to a large sample of patients from Europe, we assessed the score validity and efficacy in a separate population.

As expected, our results show that score performance in this validation cohort was not as good as that seen in the development cohort. Score sensitivity was 78% and specificity was 74%, whereas in the development cohort it was 100% and 92%,¹⁰ respectively. This may be explained by different characteristics of SFTPs resected in both populations, as more tumors in the European validation cohort exhibited characteristics associated with malignant behavior. For example, only 27.1% of patients in the American cohort had tumors arising from the parietal pleura compared with 42.5% in the current validation cohort.¹⁰ The same held true for other variables included in the score when comparing the American development cohort and the European validation cohort, such as sessile morphology (33.3% vs 46.9%), size ≥ 10 cm (25% vs 34.5%), hypercellularity (24% vs 38.9%), necrosis or hemorrhage (10% vs 27.4%), and ≥ 4 mitoses/10 HPFs (7% vs 18.6%).¹⁰ The higher frequency of these characteristics resulted in a higher median score of 2 points in the European cohort compared with 1 point in the American cohort.¹⁰ Nonetheless, in spite of a higher proportion of patients exhibiting tumor characteristics associated with malignant behavior, we only observed a recurrence rate of 8%, compared with a 14% recurrence rate reported in the American population¹⁰ and a 10% to 15% recurrence rate reported in contemporary surgical series.²⁻⁶

Figure 2 – A, B, Kaplan-Meier recurrence curves for the entire cohort (A) and according to risk stratification based on the scoring system (B). C, D, Overall survival curves for the entire cohort (C) and according to risk stratification based on the scoring system (D).

We have also demonstrated that the proposed score performed significantly better in this validation population compared with previously published criteria to determine malignant behavior, specifically, the criteria by England et al⁸ and the classification by de Perrot et al.⁹ Additionally, the scoring system remained valid upon classifying patients according to their risk of SFTP recurrence when using a cutoff of 3 points. In patients classified at low risk (< 3 points), we observed very low recurrence rates of 1.3%, 1.3%, and 3.5% at 5, 10, and 15 years, respectively, compared with recurrence rates of 13.5%, 17.5%, and 27.9% in patients classified at high risk (≥ 3 points).

Additionally, we showed that the score correlates with variables that serve as indicators of disease severity, such as the extent of surgical resection, the need for adjuvant therapy, and to some degree postoperative complications. Also, we demonstrated a significant association between higher scores and worse overall survival, which

was not observed in the development cohort.¹⁰ Although the scoring system was developed to predict SFTP recurrence, its association with overall survival is interesting but will need further validation and should be viewed with caution, as detailed data on the cause of death for the present cohort were not available. This proposed score is easy to implement in the clinical setting and does not require additional testing outside of the routine evaluation for SFTP. The capacity of the present score to classify patients according to their risk of recurrence may prove useful to guide postoperative surveillance. Patients classified at low risk may benefit from a less aggressive postoperative surveillance strategy and would not be routinely considered for adjuvant therapies. However, patients with SFTPs and high scores who are deemed high risk for recurrence may be selected for a much more aggressive surveillance imaging strategy and/or consideration of clinical trials that examine the efficacy of adjuvant therapy. The superior performance of the proposed score when compared with other existing

de Perrot AUC-ROC = 0.5235; England AUC-ROC = 0.6966

Figure 3 – Comparison of ROC curves for the recurrence score against the criteria of England et al⁸ and the classification of de Perrot et al.⁹ AUC = area under the curve. See Figure 1 legend for expansion of other abbreviation.

clinical classifications for this infrequent neoplasm supports its use to aid in clinical decision-making. To of our knowledge, there is no better prognostic tool for SFTP to date.

We recognize that the proposed scoring system has limitations. First, this is a retrospective review that is limited by the quality and accuracy of the medical records. Additionally, the prognostic value of molecular bio-

markers has been studied in patients with SFTPs; Ki67 proliferation index > 10% or high expression of p53 have been associated with tumor recurrence and worse disease-free survival in patients with SFTP.^{4,10} The addition of these markers and others could supplement the predictive strength of the current score. A detailed analysis of molecular biomarkers was not possible in the present study. Currently, there is no evidence suggesting that earlier detection of recurrences has a positive impact on long-term survival. However, this lack of evidence is mainly due to the rarity of this neoplasm, which has limited the analysis of outcomes to case series from single institutions. This, together with the lack of uniformity in the classification of patients, has prevented comparisons between series. We expect that the application of the scoring system will facilitate the construction of evidence for this infrequent tumor.

Conclusions

A proposed scoring system that uses common clinical and histologic features of resected SFTPs proved to be useful to classify patients according to their risk of recurrence. Here, we have proved the validity of the scoring system in a larger and completely different population compared with the original development cohort. This score is easy to implement and convenient for clinical application. This score should be calculated for patients undergoing surgical treatment of SFTP to guide postoperative surveillance and provide discrimination of which patients might benefit from adjuvant therapies.

Acknowledgments

Author contributions: M. L. had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. L. F. T. and H. L. contributed to the study design, statistical analysis, and manuscript writing; and O. M., M. R. G., B. L., D. J. M., P. D., and M. L. contributed to the study design, data collection, and manuscript writing.

Financial/nonfinancial disclosures: The authors have reported to *CHEST* that no potential conflicts of interest exist with any companies/organizations whose products or services may be discussed in this article.

Role of sponsors: The Harvard Catalyst Program provided statistical analysis support. The content is solely the responsibility of the authors and does not necessarily represent the official views of Harvard Catalyst, Harvard University and its affiliated academic health care centers, or the National Institutes of Health.

References

1. Abu Arab W. Solitary fibrous tumours of the pleura. *Eur J Cardiothorac Surg*. 2012;41(3):587-597.
2. Cardillo G, Carbone L, Carleo F, et al. Solitary fibrous tumors of the pleura: an analysis of 110 patients treated in a single institution. *Ann Thorac Surg*. 2009;88(5):1632-1637.
3. Harrison-Phipps KM, Nichols FC, Schleck CD, et al. Solitary fibrous tumors of the pleura: results of surgical treatment and long-term prognosis. *J Thorac Cardiovasc Surg*. 2009;138(1):19-25.
4. Schirosi L, Lantuejoul S, Cavazza A, et al. Pleuro-pulmonary solitary fibrous tumors: a clinicopathologic, immunohistochemical, and molecular study of 88 cases confirming the prognostic value of de Perrot staging system and p53 expression, and evaluating the role of c-kit, BRAF, PDGFRs (alpha/beta), c-met, and EGFR. *Am J Surg Pathol*. 2008;32(11):1627-1642.
5. Rosado-de-Christenson ML, Abbott GF, McAdams HP, Franks TJ, Galvin JR. From the archives of the AFIP: localized fibrous tumor of the pleura. *Radiographics*. 2003;23(3):759-783.
6. Sung SH, Chang JW, Kim J, Lee KS, Han J, Park SI. Solitary fibrous tumors of the pleura: surgical outcome and clinical course. *Ann Thorac Surg*. 2005;79(1):303-307.
7. Lahon B, Mercier O, Fadel E, et al. Solitary fibrous tumor of the pleura: outcomes of 157 complete resections in a single center. *Ann Thorac Surg*. 2012;94(2):394-400.
8. England DM, Hochholzer L, McCarthy MJ. Localized benign and malignant fibrous tumors of the pleura. A clinicopathologic review of 223 cases. *Am J Surg Pathol*. 1989;13(8):640-658.
9. de Perrot M, Fischer S, Bründler MA, Sekine Y, Keshavjee S. Solitary fibrous tumors of the pleura. *Ann Thorac Surg*. 2002;74(1):285-293.
10. Tapias LF, Mino-Kenudson M, Lee H, et al. Risk factor analysis for the recurrence of resected solitary fibrous tumours of the pleura: a 33-year experience and proposal for a scoring system. *Eur J Cardiothorac Surg*. 2013;44(1):111-117.