SARCOIDOSIS VASCULITIS AND DIFFUSE LUNG DISEASES 2017; 34; 35-40 DOI: 10.36141/svdld.v34i1.5172

Body Mass Index and arterial blood oxygenation as prognostic factors in patients with idiopathic pleuroparenchymal fibroelastosis

Hiroki Hayashi[1], Takahito Nei[1], Shinji Abe[1], Yoshinobu Saito[1], Nariaki Kokuho[1], Kenichiro Atsumi[1], Kazue Fujita[1], Takefumi Saito[2], Takahiro Tanaka[3], Akihiko Gemma[1], Arata Azuma[1]

[1] Department of Respiratory Medicine, Nippon Medical School; [2] Department of Respiratory Medicine, National Hospital Organization, Ibarakihigashi National Hospital; [3] Bioscience Medical Research Center, Niigata University Medical and Dental Hospital

Abstract. *Background:* Idiopathic pleuroparenchymal fibroelastosis (IPPFE) was recently proposed as an entity to be included among rare idiopathic interstitial pneumonias (IIPs). However, the cause, clinical features and prognosis of this rare entity have not been elucidated. *Objectives:* We aimed to examine the clinical features, outcomes and prognostic factors for IPPFE in comparison to those of idiopathic pulmonary fibrosis (IPF). *Methods:* We retrospectively analyzed 20 patients with IPPFE and 71 with IPF. We compared clinical features, blood examination data, and respiratory functions at the time of diagnosis. *Results:* The IPPFE group had a significantly lower body mass index (BMI), percent forced vital capacity (%FVC), total lung capacity (%TLC) and expiratory reserve volume (%ERV), as well as a higher residual volume to TLC (RV/TLC) ratio than the IPF group. The annual FVC changes in the IPPFE group (-326ml/year) were significantly larger than those in the IPF group (-142ml/year). Survival was significantly poorer in the IPPFE than in the IPF group (P = 0.021). BMI and the partial pressure of oxygen in arterial blood (PaO_2) were significantly related to the outcome of IPPFE. *Conclusions:* Our present results indicate the prognosis of IPPFE patients to be poorer than that of IPF patients. We advocate that BMI and arterial blood PaO_2 be determined at the first visit as these parameters are closely related to patients' outcomes. Prospective evaluation of IPPFE starting in the subclinical phase is necessary to assure that appropriate measures are taken before progression. *(Sarcoidosis Vasc Diffuse Lung Dis 2017; 34: 35-40)*

Key words: idiopathic pleuroparenchymal fibroelastosis (IPPFE), idiopathic pulmonary fibrosis (IPF), prognostic factors, pulmonary function

Introduction

Pleural thickening of the apical area has conventionally been called pulmonary apical cap (PAC) (1-3). If a PAC case has no symptoms, we regard the lesion as being non-progressive. However, unusual case series with progressive pulmonary disease, showing decreases in both superior lobe volumes, have been reported (4). The details of these progressive pulmonary diseases were described and a new condition named idiopathic pulmonary upper lobe fibrosis (IPUF) was proposed (5).

Previous reports have described unusual pulmonary disorders (6-9) with the following pathological features; belt-shaped fibrosis and atelectasis are detectable directly under the pleura with superior lobe predominance, and there is nonspecific pulmonary fibrosis with an internal cystic lesion. Depending on

Received: 30 January 2016
Accepted after revision: 1 April 2016
Correspondence: Takahito Nei, M.D.
Department of Infection Control and Prevention,
Nippon Medical School, 1-1-5 Sendagi,
Bunkyo-Ward, Tokyo, Japan, 113-8603
Tel. +81-3-3822-2131 (Ext. 6192)
Fax +81-3-5814-6616
E-mail addresses: takahitonei@gmail.com

the clinical course, such a pulmonary lesion can expand to the inferior lobe. The pathological entity of idiopathic pleuroparenchymal fibroelastosis (IPPFE) was proposed in 2004 (10). IPPFE is characterized by elastic fiber hyperplasia in a pleural lesion with superior lobe predominance and fibrosis of the adjacent lung parenchyma, particularly of the alveolar septum.

Moreover, IPPFE is described as a group of rare idiopathic interstitial pneumonias (IIPs) in the American Thoracic Society (ATS)/European Respiratory Society (ERS) combination statement of 2013 (11). Other than idiopathic causes, acid-fast bacillus infection, pneumoconiosis, ankylosing spondylitis, pneumoconiosis, sarcoidosis, rheumatoid lung, ulcerative colitis (12), super alloy lungs (13), and pulmonary complications after bone marrow transplantation (14, 15) may show similar upper lobe fibrosis.

Recent infections, with genetic and autoimmune predispositions as background factors, are assumed to contribute to these changes (16), but little is known regarding the etiology and prognosis of IPPFE.

In this study, we retrospectively analyzed clinical characteristics and respiratory functions employing follow-up data of 20 IPPFE cases for comparison with those of idiopathic pulmonary fibrosis (IPF) cases.

Material and Methods

Patients

We reviewed clinical data from patients diagnosed with IPPFE at Nippon Medical School Hospital, Tokyo and National Hospital Organization, Ibarakihigashi National Hospital, Ibaraki, from 2005 to 2013. IPPFE was diagnosed using high-resolution computed tomography (HRCT) images, based on previous reports (10, 16). The following findings were taken to indicate IPPFE: (1) pleural thickening with associated subpleural fibrosis concentrated in the upper lobe; (2) lower lobe involvement less marked or absent.

We excluded cases with definite autoimmune diseases, chronic hypersensitivity pneumonitis and malignant tumor. Secondary PPFE patients, such as those with upper lobe fibrosis after bone marrow and lung transplantation, were not included. This retrospective study was approved by the institutional review boards of Nippon Medical School (number 27-04-439) and Ibarakihigashi Hospital (number 2015-001), and patient consent was not required.

Generally, IPF, a chronic, progressive, and fatal disease, is the most common form of idiopathic interstitial pneumonia. Therefore, it is reasonable to compare IPPFE with IPF in terms of demographics and survival. We thus selected IPF patients as controls for those with IPPFE. These IPF cases were followed at Nippon Medical School Hospital during the same period. We evaluated characteristics and prognostic factors in both IPPFE and IPF patients. The diagnosis of IPF was based on a previously published IPF guideline (17) using HRCT images. Briefly, the criteria were reticular shadows or honeycomb-formation adjacent to the pleura with lower lung predominance, findings categorized into the pathological pattern of usual interstitial pneumonia (UIP). Patients with possible UIP pattern or inconsistent with UIP pattern were not included in the comparative group. We also excluded cases with lung cancer and so-called combined pulmonary fibrosis and emphysema (CPFE).

Clinical assessment

We reviewed age, gender, smoking history, and body mass index (BMI) at the time of diagnosis. We calculated BMI based on the following formula. BMI=weight (kg)/(height [m])^2. The partial pressures of oxygen (PaO_2) and carbon dioxide ($PaCO_2$), as well as the pH, of arterial blood at rest in the supine position, using an automatic blood gas analyser, were recorded.

Pulmonary function tests

Pulmonary function parameters, including forced vital capacity (FVC), forced expiratory volume in 1.0 second (FEV1), total lung capacity (TLC), lung diffusion capacity of carbon monoxide (DLco), ratio of residual volume per total lung capacity (RV/TLC), and expiratory reserve volume (ERV), were measured according to the ATS guidelines (18) using a pulmonary function instrument with computer processing (CHESTAC 8900 (NIHON KOHDEN, Tokyo, Japan)). Each analysis was performed at least

three times during the study period. We evaluated pulmonary function changes in each individual by linear regression analysis, as described in previous reports (19, 20). We excluded cases with 0-2 respiratory function tests during the follow-up period of this analysis.

Statistical analyses

Statistical analyses were performed on a microcomputer using JMP software (SAS Institute, Cary, NC). Numerical data were evaluated for a normal distribution using the Shapiro-Wilk test and for equal variance using the Levine median test. Statistical comparisons of parametric data were conducted with the Student-*t* test, and of non-parametric data with the Mann-Whitney *U* test. Fisher's exact test was used to compare the data classified in two categories. The Kaplan-Meier survival curves were compared using the log-rank test. Each of the physiological and prognostic factors were subjected to univariate analysis. Multivariate analyses were conducted using the Cox proportional hazard model. *P* values <.05 were considered significant.

Results

Clinical characteristics

Twenty patients diagnosed with IPPFE based on HRCT findings were enrolled in the present study, and 71 with IPF were enrolled as a control group. Demographic features including the observation period, age, gender, BMI, smoking status, pulmonary function tests, serum markers and arterial blood gas analysis results at the first visit were recorded (Table 1). The observation period and age at baseline of the

Table 1. Demographic data of PPFE and IPF subjects

Characteristics	PPFE (n=20)	IPF (n=71)	*P* values
Observation period (days)[§]	1017.1±535.3	1251.0±766.8	*NS*[†]
Age at baseline (years)[#]	68.5 (46-85)	70.1 (50-89)	*NS*[†]
Gender			
male/female	12/8 (60%)	60/11 (84.5%)	<.05[‡]
Body mass index (kg/m2)[§]	18.7±3.3	23.8±2.6	<.0001[†]
Smoking history (number)		10/20	59/71
pack-years[§]	8.9±15.6	30.5±27.2	0.001[†]
Pulmonary function test[§]			
FVC (ml)	1959±844 (n=18)	2653±645 (n=71)	<.001[†]
FVC %predicted	67.5±23.5 (n=18)	85.5±19.5 (n=71)	<.01[†]
FEV1 (ml)	1847±731 (n=19)	2226±530 (n=71)	<.05[†]
FEV1 %predicted	87.2±27.7 (n=19)	98.6±20.7 (n=71)	<.05[†]
FEV1/FVC ratio	93.4±7.9 (n=17)	84.4±6.4 (n=71)	<.0001[†]
TLC (ml)	3435±1231 (n=13)	3948±797 (n=69)	*NS*[†]
TLC %predicted	74.3±20.2 (n=13)	78.5±15.1 (n=69)	*NS*[†]
DLco	12.6±5.0 (n=11)	11.9±3.4 (n=63)	*NS*[†]
DLco %predicted	79.4±25.5 (n=11)	72.7±22.0 (n=63)	*NS*[†]
ERV (ml)	754±400 (n=18)	1004±338 (n=71)	<.01[†]
ERV %predicted	62.5±25.8 (n=18)	76.9±25.2 (n=71)	<.05[†]
RV/TLC	48.1±9.5 (n=13)	32.4±7.1 (n=69)	<.0001[†]
Serum Markers[§]			
KL-6 (U/ml)	615±322 (n=19)	1347±919 (n=71)	0.001
SP-D (ng/ml)	199±92 (n=19)	200±118 (n=69)	*NS*[†]
SP-D /KL-6	0.41±0.27 (n=19)	0.18±0.12 (n=69)	<.0001[†]
Arterial Blood Gas[§¶]			
PaO2 (*Torr*)	85.8±14.7 (n=15)	78.2±16.2 (n=38)	*NS*[†]
PaCO2 (*Torr*)	45.6±6.5 (n=15)	40.2±5.2 (n=38)	<.01[†]

[#]Data expressed as medians (range); [†]Data analyzed by Mann-Whitney *U-test*; [‡]Data analyzed by Fisher's exact test.
[¶]Measures conducted with patient in supine position and breathing room air
Abbreviations: PPFE, pleuroparenchymal fibroelastosis; IPF, idiopathic pulmonary fibrosis; FVC, forced vital capacity; FEV1, forced expiratory volume in 1 s; TLC, total lung capacity; DLCO, diffusion capacity for carbon monoxide; ERV, exipiratory reverse volume; RV, residual volume; KL-6, Kreb von den Lungen-6; SP-D, surfactant protein D; NS, not significant

IPPFE group were similar to those of the IPF group. However, the gender ratio, BMI and pack years of the IPPFE group were significantly lower than those of the IPF group (P<.05, P<.0001 and P<.001, respectively). $PaCO_2$ was significantly higher in the IPPFE than in the IPF group, while PaO_2 did not differ significantly between the two.

Pulmonary function tests and their annual changes

Several pulmonary function parameters, including FVC, FVC as percent predicted; %FVC, FEV1, FEV1 as percent predicted; FEV1%, ERV, and ERV as percent predicted; %ERV, were significantly lower in the IPPFE than in the IPF group, whereas RV/TLC was significantly higher in the IPPFE than in the IPF group. The other pulmonary function parameters (DLco and DLco as percent predicted; %DLco) did not differ significantly between the two groups. In addition, the annual changes in FVC in the IPPFE group (-326ml/year) were significantly greater than those in the IPF group (-142ml/year) (Table 2).

Clinical outcomes

The average observation period of all enrolled cases was 1,200 days (115~4,234). Thirty-four cases died of the original disease (37.4%), 10 IPPFE cases (50.0%) and 24 IPF cases (32.4%). In the IPPFE group, eight of the 10 deaths were due to progression of type II respiratory failure. None of these cases had malignant tumors, such as lung cancer, during observation period. (Supplementary Appendix)

Table 2 Annual changes per year in respiratory function parameters

	IPPFE (n=20)	IPF (n=71)	*P* values
FVC (ml)	-326 (n=16)	-142 (n=59)	<.01†
FVC%predicted	-10 (n=16)	-3.9 (n=59)	<.01†
TLC (ml)	-580 (n=10)	-430 (n=57)	*NS*†
TLC%predicted	-10.7 (n=10)	-4.1 (n=57)	<.05†
DLco (mL/min/mmHg)	-2.84 (n=12)	-1.49 (n=54)	*NS*†
DLco %predicted	-6.8 (n=12)	-8.2 (n=54)	*NS*†
ERV (ml)	-67 (n=15)	-39 (n=59)	*NS*†
ERV %predicted	-3.7 (n=15)	-2.8 (n=59)	*NS*†

†Data analyzed by Mann-Whitney *U*-test.
Abbreviations : FVC, forced vital capacity; FEV1, forced expiratory volume in 1 s; TLC, total lung capacity; DLCO, diffusion capacity for carbon monoxide; ERV, expiratory reverse volume; KL-6, Kreb von den Lungen-6; SP-D, surfactant protein D; *NS*, not significant

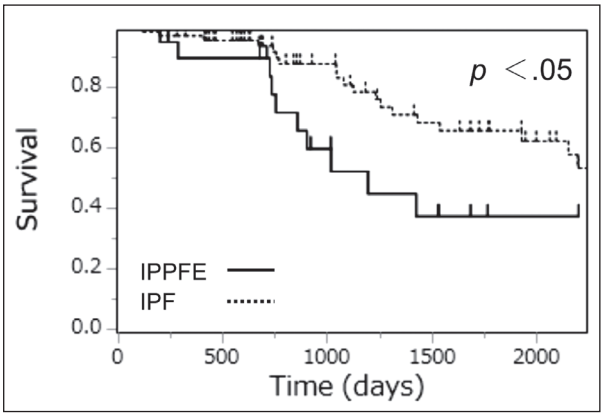

Fig. 1. Survival rates of all patients with IPPFE (20 cases) and IPF (71 cases), as analyzed employing Kaplan-Meier survival curves. The survival ratio is significantly lower in IPPFE than in IPF patients (P<.05)

Kaplan-Meier survival estimates showed a higher mortality rate in the IPPFE than in the IPF group (P<.05, Figure 1). In addition, BMI and PaO_2 were significantly related to patient outcomes when the univariate Cox proportional hazard model was applied. In the multivariate Cox proportional hazard model, BMI and PaO_2 were significantly associated with poorer outcomes (Table 3).

Discussion

IPPFE has increasingly been attracting attention since this entity is included among the rare IIPs, as described in the ATS/ERS combination statement in 2013 (11). In this study, we examined and evaluated the clinical features of 20 patients with definite IPPFE and compared the findings with those of IPF. The IPPFE patients showed a restrictive ventilatory impairment and elevation of RV/TLC at the first visit. Furthermore, a relatively rapid decrease in FVC and progression of type II respiratory failure were observed. We also recognized IPPFE as a pulmonary disease with a poorer prognosis than IPF, the most common form of the IIPs, and significant prognostic factors included BMI and PaO_2.

A previous study (21) of IPPFE highlighted declining FVC. However, we assessed not only FVC but also the survival ratio using multivariate analysis for patients with IPPFE.

Based on the survival analysis, our data indicate IPPFE to have a significantly poorer prognosis than

Table 3 Prognostic factors in subjects with IPPFE

	HR [95% CI]	*P* values
Univariate Cox Regression Model		
General		
Age	0.995 [0.929-1.068]	*NS*
Male Gender	1.027 [0.292-4.035]	*NS*
BMI	0.755 [0.571-0.961]	<.05
Serum markers		
KL-6	1.000 [0.998-1.002]	*NS*
SP-D	1.002 [0.996-1.007]	*NS*
Arterial Blood Gases		
PaO_2	0.884 [0.786-0.964]	<.01
$PaCO_2$	0.918 [0.804-1.040]	*NS*
Pulmonary Function Tests		
FVC	0.330 [0.088-1.085]	*NS*
FEV_1	0.475 [0.134-1.548]	*NS*
DLco	1.023 [0.757-1.295]	*NS*
ERV	0.103 [0.005-1.050]	*NS*
TLC	0.427 [0.145-1.041]	*NS*
RV/TLC	1.042 [0.960-1.124]	*NS*
Multivariate Cox Regression Model		
BMI	0.610 [0.307-0.933]	<.05
PaO_2	0.867 [0.736-0.959]	<.05

Abbreviations: PPFE, pleuroparenchymal fibroelastosis; FVC, forced vital capacity; FEV1, forced expiratory volume in 1 s; TLC, total lung capacity; DLCO, diffusion capacity for carbon monoxide; KL-6, Kreb von den Lungen-6; SP-D, surfactant protein D, *NS*; not significant

IPF with BMI and PaO_2 being significant prognostic factors. Amitani et al. reported IPPFE to be characterized by shadows at the superior lobe-based apical cap, with slow progression to the deeper portion of the lung, and that patients with IPPFE often die during a clinical course of 10~20 years (5). On the other hand, Watanabe et al. analyzed and evaluated 7 IPPFE cases who had been diagnosed pathologically and followed their FVC changes over time. These IPPFE cases showed rapid annual declines in FVC and their outcomes were poor (19). Other similar studies also documented poor outcomes of IPPFE cases (16, 22). We consider the timing of the initial IPPFE diagnosis to reflect prognostic differences. Chest X-rays are now widely performed and we have numerous opportunities to identify lesions in the apical area, though we tend to regard pleural thickening in the apex as merely an old inflammatory lesion. We speculate that the diagnosis of IPPFE is often delayed because the onset of symptoms is late, not manifesting until the patient's condition has significantly progressed.

Furthermore, IPPFE in patients with rapidly decreasing respiratory function ultimately progresses to a "negative spiral" stage, in which ever-worsening deterioration and "cachexia" lead to weight loss and thereby to worsening of systemic status. Weight loss can lead to decreased protein synthesis and promote the productions of inflammatory cytokines (e.g. TNF-α) and the receptor of soluble TNF-α, because mechanical overload increases energy demand via elevated respiratory muscle energy consumption (hypermetabolism). Amitani et al. described IPUF patients as characteristically being underweight (5). In fact, we advocate immediate nutritional intervention because BMI was demonstrated in our study to be a prognostic factor. Furthermore, appropriate physical rehabilitation seems to be necessary to achieve body weight stabilization and muscle preservation.

Our study has several limitations. First, IPPFE is a diagnosis originally based on pathological findings characterized as follows: "elastic fiber increases cause fibroelastosis which accelerates under the pleura of the superior lobe" (16, 23). In this study, IPPFE was diagnosed in only five cases based on pathological findings. Therefore, we cannot completely rule out the possibilities of other diseases. However, previous reports have described secondary, refractory pneumothorax after surgical lung biopsy in IPPFE patients (23). Since there is no curative treatment for IPPFE other than lung transplantation, we should avoid such biopsies. A recent publication noted that "Biopsy is NOT a prerequisite for PPFE diagnosis" (24). Second, this was a case control study based on a retrospective chart review with a small sample size.

Conclusion

Our present study showed IPPFE to have a poorer prognosis than IPF. We consider BMI and arterial blood PaO_2 at the first visit to be closely related to patient outcomes.

Acknowledgements

We thank Bierta Barfod for editing the manuscript and Hiromi Watanabe for secretarial assistance. We are grateful to Drs. Kazutaka Fujita, Jun Kanazawa, and Kenji Nemoto for permission to use the clinical data.

Authors' contributions:
H.H. designed the study; H.H. and T.N. wrote the manuscript; S.A., T.S. gave helpful suggestions regarding the manuscript. H.H. and T.T. performed the statistical analysis. T.N., Y.S., N.K., K.A., K.F., T.S., A.G., and A.A. actually treated the surveyed cases both at the outpatient department and during hospitalization

All of the authors have read and approved the final manuscript.

References

1. Butler C, Kleinerman J. The pulmonary apical cap. Am J Pathol 1970; 60: 205-216.
2. Yousem SA. Pulmonary apical cap: a distinctive but poorly recognized lesion in pulmonary surgical pathology. Am J Surg Pathol 2001; 25: 679-683.
3. Hirami Y, Nakata M, Maeda A, Yukawa T, Shimizu K, Tanemoto K. Pulmonary apical mass, the so-called pulmonary apical cap, in a 43-year-old woman. Ann Thorac Cardiovasc Surg 2010; 16: 122-124.
4. Repo UK, Kentala E, Koistinen J, Lehtipuu AL, Miettinen A, Pyrhonen S, et al. Pulmonary apical fibrocystic disease. A serologic study. Eur J Respir Dis 1981; 62: 46-55.
5. Amitani R, Niimi A, Kuze F. Idiopathic pulmonary upper lobe fibrosis. Kokyu 1992; 11: 693-699.
6. Shiota S, Shimizu K, Suzuki M, Nakaya Y, Sakamoto K, Iwase A, et al. Seven cases of marked pulmonary fibrosis in the upper lobe. Nihon Kokyuki Gakkai Zasshi 1999; 37: 87-96.
7. Jingu K, Kawana A, Furihata K. Two cases of marked pulmonary fibrosis in the upper lung field. Kokyu 1999; 18: 318-323.
8. Kobayashi Y, Sakurai M, Kushiya M, Mizukoshi T, Nishi Y, Choo JH, et al. Idiopathic pulmonary fibrosis of the upper lobe: a case report. Nihon Kokyuki Gakkai Zasshi 1999; 37: 812-816.
9. Kobashi Y, Ohba H, Yoneyama H. A case of so-called "idiopathic pulmonary upper lobe fibrosis" complicated by both mediastinal emphysema and bilateral pneumothorax at different rimes. Kokyu 2000; 19: 292-298.
10. Frankel SK, Cool CD, Lynch DA, Brown KK. Idiopathic pleuroparenchymal fibroelastosis: description of a novel clinicopathologic entity. Chest 2004; 126: 2007-2013.
11. Travis WD, Costabel U, Hansell DM, King TE,Jr, Lynch DA, Nicholson AG, et al. ATS/ERS Committee on Idiopathic Interstitial Pneumonias. An official American Thoracic Society/European Respiratory Society statement: Update of the international multidisciplinary classification of the idiopathic interstitial pneumonias. Am J Respir Crit Care Med 2013; 188: 733-748.
12. Singh R, Sundaram P, Joshi JM. Upper lobe fibrosis in ulcerative colitis. J Assoc Physicians India 2003; 51: 515-517.
13. Kaneko Y, Kikuchi N, Ishii Y, Kawabata Y, Moriyama H, Terada M, et al. Upper lobe-dominant pulmonary fibrosis showing deposits of hard metal component in the fibrotic lesions. Intern Med 2010; 49: 2143-2145.
14. von der Thusen JH, Hansell DM, Tominaga M, Veys PA, Ashworth MT, Owens CM, et al. Pleuroparenchymal fibroelastosis in patients with pulmonary disease secondary to bone marrow transplantation. Mod Pathol 2011; 24(12): 1633-1639.
15. Fujikura Y, Kanoh S, Kouzaki Y, Hara Y, Matsubara O, Kawana A. Pleuroparenchymal fibroelastosis as a series of airway complications associated with chronic graft-versus-host disease following allogeneic bone marrow transplantation. Intern Med 2014; 53(1): 43-46.
16. Reddy TL, Tominaga M, Hansell DM, von der Thusen J, Rassl D, Parfrey H, et al. Pleuroparenchymal fibroelastosis: a spectrum of histopathological and imaging phenotypes. Eur Respir J 2012; 40: 377-385.
17. Raghu G, Collard HR, Egan JJ, Martinez FJ, Behr J, Brown KK, et al. ATS/ERS/JRS/ALAT Committee on Idiopathic Pulmonary Fbrosis. An official ATS/ERS/JRS/ALAT statement: idiopathic pulmonary fibrosis: evidence-based guidelines for diagnosis and management. Am J Respir Crit Care Med 2011; 183: 788-824.
18. American Thoracic Society. Standardization of Spirometry, 1994 Update. Am J Respir Crit Care Med 1995; 152: 1107-1136.
19. Watanabe K, Nagata N, Kitasato Y, Wakamatsu K, Nabeshima K, Harada T, et al. Rapid decrease in forced vital capacity in patients with idiopathic pulmonary upper lobe fibrosis. Respir Investig 2012; 50: 88-97.
20. Kim YJ, Shin SH, Park JW, Kyung SY, Kang SM, Lee SP, et al. Annual Change in Pulmonary Function and Clinical Characteristics of Combined Pulmonary Fibrosis and Emphysema and Idiopathic Pulmonary Fibrosis: Over a 3-Year Follow-up. Tuberc Respir Dis 2014; 77: 18-23.
21. Oda T, Ogura T, Kitamura H, Hagiwara E, Baba T, Enomoto Y, et al. Distinct characteristics of pleuroparenchymal fibroelastosis with usual interstitial pneumonia compared with idiopathic pulmonary fibrosis. Chest 2014; 146: 1248-1255.
22. Enomoto N, Kusagaya H, Oyama Y, Kono M, Kaida Y, Kuroishi S, et al. Quantitative analysis of lung elastic fibers in idiopathic pleuroparenchymal fibroelastosis (IPPFE): comparison of clinical, radiological, and pathological findings with those of idiopathic pulmonary fibrosis (IPF). BMC Pulm Med 2014; 28;14: 91-2466-14-91.
23. Becker CD, Gil J, Padilla ML. Idiopathic pleuroparenchymal fibroelastosis: an unrecognized or misdiagnosed entity? Mod Pathol 2008; 21: 784-787.
24. Camus P, von der Thusen J, Hansell DM, Colby TV. Pleuroparenchymal fibroelastosis: one more walk on the wild side of drugs? Eur Respir J 2014; 44: 289-296.