Chronic Obstructive Pulmonary Disease Is Common in Never-smoking Patients with Primary Sjögren Syndrome

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ABSTRACT. ***Objective.*** To assess the prevalence of chronic obstructive pulmonary disease (COPD) in patients with primary Sjögren syndrome (pSS) and to study the association of COPD with cigarette smoking, radiographic features, respiratory symptoms, disease activity, and laboratory inflammatory and serological features in patients with pSS.

Methods. Fifty-one consecutive patients with pSS (mean age 60 yrs, range 29–82 yrs, 49 women) were assessed by pulmonary function tests (PFT). The PFT results were compared with previously studied population-based controls, standardizing results with regard to sex, age, height, weight, and cigarette smoking. In addition, patients with pSS were assessed by computed tomography of the chest, the European League Against Rheumatism Sjögren Syndrome Disease Activity Index and Patient Reported Index, the St. George's Respiratory Questionnaire (which evaluates respiratory symptoms), and by laboratory inflammatory and serological tests.

Results. Forty-one percent of all patients with pSS and 30% of the never-smoking patients with pSS fulfilled the Global Initiative for Chronic Obstructive Lung Disease criteria for COPD. Vital capacity (VC), forced expiratory volume in 1 s (FEV_1), FEV_1/VC ratio, and DLCO were significantly decreased while residual volume (RV) and the RV/total lung capacity ratio were significantly increased in patients with pSS. Moderate correlations between PFT results, symptoms, and disease activity were found. However, laboratory inflammatory and serological features were poorly associated with PFT results in patients with pSS.

Conclusion. COPD was a common finding in patients with pSS, even among never-smoking patients. An obstructive pattern was the predominant PFT finding in patients with pSS, although a superimposed restrictive lung disease could not be excluded. The results suggest that the disease *per se* is involved in the development of COPD in pSS. (First Release Jan 15 2015; J Rheumatol 2015;42:464–71; doi:10.3899/jrheum.140370)

Key Indexing Terms:
SJÖGREN SYNDROME LUNG DISEASES DIAGNOSTIC IMAGING RADIOGRAPHY

Primary Sjögren syndrome (pSS) is a systemic autoimmune disease, characterized by lymphocytic infiltration of the exocrine glands, leading to a decreased production of secretion and sicca symptoms. Systemic nonexocrine features, afflicting various organ systems including the lungs, are often encountered in the disease[1,2,3,4,5,6,7,8,9,10,11,12,13] and respiratory symptoms, such as cough and dyspnea being common in patients with pSS[2,3,4,5,6,8,9,10,11,12,13]. Both airways, lung parenchyma, lymphoid structures, and pleural and pulmonary vascular components may be involved in the disease. Several studies have assessed pulmonary involvement in pSS with differences in reported prevalence (9–90%), as well as with regard to the type of pulmonary involvement, possibly because of differences in methodology, the use of different classification criteria for pSS, and selection bias[1,2,3,4,5,6,7,8,9,10,11,12,13]. Abnormalities in pulmonary function in pSS include both obstructive and restrictive lung disease, and both entities may well coexist in the same patient[8,10,11]. Two studies reported small airway obstruction as a common finding in pSS[8,10], and in a longitudinal study by our group, patients with pSS were frequently found to develop chronic obstructive pulmonary disease (COPD), although the vast majority of the patients

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importantly had not been smoking during followup[8]. Considering the reported increased mortality in patients with pSS who had pulmonary involvement[9], early detection seems important, especially if better treatment options, preventing deterioration of the pSS-associated pulmonary disease, become available in the future. In our previous longitudinal study on COPD development in pSS[8], most patients with pSS were investigated by pulmonary function tests (PFT) because of respiratory symptoms at baseline; thus, not allowing assessment of COPD prevalence among patients with pSS in general. Therefore, the aims of our study were to assess COPD prevalence in an unselected pSS population, as well as its relation to cigarette smoking, radiographic features, respiratory symptoms, disease activity, and laboratory and serological features of the disease.

MATERIALS AND METHODS

Patients. Consecutive patients with pSS, diagnosed according to the American-European Consensus Group (AECG) criteria for Sjögren syndrome[14], were asked to participate in the study. They were seen as outpatients from May to December 2012 at the Department of Rheumatology, Skåne University Hospital, Malmö, Sweden. Of the 56 patients invited, 5 declined participation. Thus, 51 patients with pSS (mean age 60 yrs, range 29–82 yrs, 49 women) were included in the study, 37 of whom also fulfilled the provisional 2012 American College of Rheumatology criteria for pSS[15]. The prevalence of previously diagnosed obstructive lung disease was not known. However, 10% of the patients had previously been diagnosed with interstitial lung disease (ILD) based on ground glass attenuations at some time. Twenty-seven of the patients with pSS were never smokers, 20 were former smokers, and 4 current smokers. Nine patients were treated with inhalation of combined long-acting β-agonists and corticosteroids, 2 patients with inhaled corticosteroids only, 2 with short-acting β-agonists, and 1 patient with long-acting anticholinergics, all of whom had to refrain from the use of these 24 h prior to PFT examination. Sixteen of the patients with pSS were treated with low-dose corticosteroids (2.5–10 mg) and 21 with disease-modifying antirheumatic drugs (16 with hydroxychloroquine, 1 with azathioprine, and 1 with cyclosporine; in addition, 3 had previously been treated with rituximab). Further characteristics are presented in Table 1.

Controls. The PFT controls consisted of 186 population-based female subjects attending a general health survey in Uppsala, 100 of whom were never smokers and 86 current smokers (mean age 45, range 20–70 yrs), and 270 population-based male subjects, also attending a general health survey in Uppsala, 124 of whom were never smokers and 146 current smokers (mean age 45, range 20–70 yrs)[16,17]. Based on the PFT results of the controls, expected PFT values could be calculated using a linear regression model into which age, height, weight, and cigarette smoking were added as covariates for women and men separately.

Pulmonary function tests. The PFT included static and dynamic spirometry, from which the vital capacity (VC), total lung capacity (TLC), residual volume (RV), forced expiratory volume in 1 s (FEV_1), FEV_1/VC ratio, and RV/TLC ratio could be calculated. DLCO was measured by the single-breath technique. FEV_1 and VC were measured before and after 1.0 mg of inhaled terbutaline [FEV_1 after reversibility test (FEV_1rev) and VC after reversibility test (VCrev)] and FEV_1 reversibility was calculated.

TLC and RV were measured by body plethysmography. Lung function tests, including calibration, were performed according to current standards[18,19,20]. PFT variables were expressed as absolute numbers and percentages of expected values. Expected PFT values were thus calculated based on the PFT results of the controls using a linear regression model as described above. COPD was defined according to the Global Initiative for Chronic Obstructive Lung Disease criteria (GOLD)[21] as FEV_1rev/VCrev ratio < 0.70. Clinically significant reversibility was defined as FEV_1 improvement > 12% and > 200 ml.

Table 1. Disease characteristics and demographics of the 51 consecutive patients with pSS. Values are mean ± SD or % with abnormal findings unless otherwise specified.

Characteristics	n = 51
Age, yrs	60 ± 12
Sex, females/males	49/2
Current/prior/never smokers, %	8/39/53
Cigarette smoking, pack-yrs	5.7 ± 9.8
Fulfilling the AECG for pSS	100
Fulfilling the provisional ACR criteria for pSS	73
Disease duration, yrs	17 ± 12
Anti-SSA antibody seropositives	78
Anti-SSB antibody seropositives	47
ANA seropositives	78
RF seropositives	51
IgG, g/l	13.8 ± 5.1
C3, g/l	1.03 ± 0.25
C4, g/l	0.18 ± 0.07
Lower lip biopsy, focus score ≥ 1	73
ESSPRI total score	6 ± 2
ESSDAI total score	7 ± 6
Nonexocrine symptoms/signs, any of the below	51
Lymphadenopathy and/or lymphoma ever	6
Arthritis ever	8
Cutaneous symptoms ever	20
Prior radiographical signs of ILD ever	10
Renal involvement ever	8
Myositis ever	0
Peripheral nervous system involvement ever	2
Raynaud phenomenon ever	8

pSS: primary Sjögren syndrome; AECG: American-European Consensus Group criteria; ACR: American College of Rheumatology; ANA: antinuclear antibody; RF: rheumatoid factor; IgG: immunoglobulin G; C3: complement factor 3; C4: complement factor 4; ESSPRI: EULAR Sjögren Patient Reported Index; ESSDAI: EULAR Sjögren Disease Activity Index; EULAR: European League Against Rheumatism; ILD: interstitial lung disease.

Disease activity and symptom measurement. Respiratory symptoms in patients with pSS were evaluated using the Swedish version of the St. George's Respiratory Questionnaire (SGRQ)[22,23], and SGRQ symptoms, activity, effect, and total scores were calculated. Scores ranged from 0 to 100 and lower scores indicated better health. Smoking habits were evaluated through a structured questionnaire assessing mean cigarette smoking, as well as the start and stop years for smoking, enabling assessment of pack-years. Disease activity for pSS was assessed by the European League Against Rheumatism (EULAR) Sjögren Syndrome Disease Activity Index (ESSDAI), and by the EULAR Sjögren Syndrome Patient Reported Index (ESSPRI), which evaluated sicca symptoms, pain, and fatigue. ESSDAI includes 12 domains; the added domain scores compose the ESSDAI total score[24]. The ESSPRI total score was the mean of the symptom scores[25].

Laboratory tests. Laboratory signs of inflammation were evaluated by assessing levels of C-reactive protein (CRP), erythrocyte sedimentation rate (ESR), immunoglobulin G (IgG), complement factor 3 (C3), and C4, in addition to the required analyses for the ESSDAI. Serologies performed in the diagnostic procedures of the disease were reassessed and included

anti-SSA and anti-SSB antibodies, as well as antinuclear antibodies (ANA) and rheumatoid factor (RF).

Computed tomography (CT) of the chest. Radiographic features of the lungs were evaluated by conventional CT of the chest. Because signs of ILD as opposed to signs of obstructive pulmonary disease were rarely detected, we mainly wanted to evaluate the latter in this study. ILD was evaluated by high-resolution CT (HRCT) scans in a previous longitudinal study evaluating pulmonary involvement in patients with pSS at our center[8]. Therefore, signs of air trapping as well as other signs of obstructive pulmonary disease were evaluated by conventional CT scans, including both inspiratory and expiratory images. Because of radiation hygienic reasons, conventional CT was chosen instead of HRCT. The images were assessed by a chest radiologist and were blinded with regard to the clinical characteristics and PFT results of the patients. The presence of a reticular pattern, ground glass attenuation, honeycombing, central as well as traction bronchiectasis, emphysema, pulmonary cysts, and air trapping was noted.

Statistics. When comparing measured and expected PFT results, the paired samples Student t test was used. Otherwise, the Student t test was used in comparisons between groups. When comparing variables with a non-normal distribution, nonparametric tests were used. Differences in categorical data were analyzed by the chi-square test and Fisher's exact test, and for correlations, Pearson correlation coefficient was calculated. P values < 0.05 were considered statistically significant.

Ethics. The study was approved by the local ethics board (Lund University 2012/98). All patients gave written informed consent according to the Declaration of Helsinki.

RESULTS

Patients with pSS showed a significantly decreased VC, FEV_1, FEV_1/VC ratio, and DLCO, as well as an increased RV and RV/TLC ratio in comparison with expected values (Table 2A). Never-smoking patients with pSS showed similar findings (Table 2B). Forty-one percent of the patients with pSS fulfilled the GOLD criteria for COPD, 61% of whom had mild and 39% moderate COPD (Table 2A). Fifty-four percent of the ever-smokers, but also 30% of the never-smokers fulfilled the GOLD criteria for COPD (Figure 1). No significant association between pSS disease duration since start of symptoms and COPD was found, not even among never-smoking patients. However, none of the 4 never-smoking patients with a short disease duration of a maximum of 5 years from diagnosis were found to have COPD. The mean disease duration was 17 years both among patients with COPD and without COPD (p = 0.939). If the respiratory domain score was excluded from the ESSDAI total score, no correlation with the PFT results was demonstrated; otherwise the ESSDAI total score inversely correlated with the percentage of VC predicted (r = –0.40, p = 0.004), TLC predicted (r = –0.40, p = 0.004), and DLCO predicted (r = –0.34, p = 0.014). The SGRQ total score also showed an inverse correlation with the percentage of VC predicted (r = –0.34, p = 0.013), TLC predicted (r = –0.29, p = 0.039), and DLCO predicted (r = –0.32, p = 0.022). In addition, there was a significant correlation between the SGRQ and ESSPRI total scores (r = 0.40, p = 0.004). Fifty-five percent of the patients with pSS demonstrated a Disease Activity Score > 0 in the respiratory domain of the ESSDAI. The ESSDAI respiratory domain score and respiratory symptoms did not significantly differ between patients with pSS with and without COPD (Table 3). Radiographic findings were common in patients with pSS (65%), of which the most common were air trapping (35%), a reticular pattern (33%), bronchiectasis (33%; 26% central and 8% peripheral traction bronchiectasis, respectively), and cysts (29%). Radiographic signs of ILD, represented by ground glass attenuation, traction bronchiectasis, or honeycombing, were demonstrated in 17% of the patients with pSS (Table 3). Radiographic findings and PFT results were generally poorly associated, although a reticular pattern, central bronchiectasis, and emphysema were significantly associated with COPD in patients with pSS (Table 3). In addition, serum levels of CRP, ESR, IgG, C3, C4, as well as presence of anti-SSA, anti-SSB, ANA, and RF were poorly associated with PFT results and radiographic signs (data not shown). VC, FEV_1, FEV_1/VC, and DLCO were significantly lower in ever-smoking patients with pSS, otherwise there were no consistent significant differences in the PFT results, radiographic findings, or laboratory findings between never- and ever-smoking patients with pSS (Table 4).

DISCUSSION

Forty-one percent of all patients with pSS and 30% of never-smoking patients with pSS fulfilled GOLD criteria for COPD, and the PFT mainly showed signs of obstructive pulmonary disease. PFT showed a moderate association with respiratory symptoms and disease activity. Limited associations were found with radiography and poor associations with laboratory inflammatory and serological features of the disease.

In a previous longitudinal study, we showed that COPD commonly developed in patients with pSS[8]. However, in that study, baseline PFT assessments of the patients with pSS were mainly performed because of respiratory symptoms. In this current study, we therefore wanted to study COPD prevalence in unselected patients with pSS visiting a rheumatology outpatient clinic, because pulmonary and airway involvement seems very common in pSS and may be underdiagnosed. The high prevalence of COPD, especially among the never-smoking patients with pSS as well as the difference in obstructive PFT variables between patients and controls taking cigarette smoking into account, suggest that the disease *per se* may result in COPD development. However, the knowledge of the exact pathogenic mechanisms behind pSS-associated small airway disease is limited. Both xerotrachea and impaired mucociliary clearance, as well as inflammatory infiltrates in the exocrine glands of the airways, may contribute to the process, progressively leading to physical obstruction as well as bronchial hyperreactivity[1,2,4,5,10,11]. In addition, parenchymal components, affecting elasticity and thereby the mechanical properties of the airways, may also be involved[1,2].

Table 2A. Results of the PFT in 51 patients with pSS compared to predicted values. Clinically significant reversibility was defined as FEV_1 improvement > 12% and > 200 ml. Values are mean ± SD or % with abnormal findings unless otherwise specified.

PFT Results	Patients with pSS, n = 51		Predicted Values, Absolute No.	p Values, pSS vs Predicted
	Absolute No.	% of Predicted		
VC, l	3.3 ± 0.8	93 ± 14	3.6 ± 0.9	0.001
TLC, l	5.6 ± 1.0	100 ± 13	5.6 ± 0.7	0.750
RV, l	2.3 ± 0.5	114 ± 23	2.0 ± 0.4	0.0001
RV/TLC ratio	0.41 ± 0.1	115 ± 18	0.36 ± 0.1	0.0001
FEV_1, l	2.3 ± 0.6	86 ± 15	2.7 ± 0.7	0.0001
FEV_1/VC ratio	0.69 ± 0.08	93 ± 10	0.75 ± 0.03	0.0001
DLCO, mmol/min kPa	6.5 ± 1.9	92 ± 18	7.0 ± 1.6	0.002
DLCO, < 80% of predicted, n (%)	12 (24)	NA	NA	
COPD, n (%)	21 (41)	NA	NA	
Mild	61	NA	NA	
Moderate	39	NA	NA	
Severe	0	NA	NA	
Clinically significant reversibility, n (%)	2 (4)	NA	NA	

Table 2B. Results of the PFT in the 27 never-smoking patients with pSS compared to predicted values. Clinically significant reversibility was defined as FEV_1 improvement > 12% and > 200 ml. Values are mean ± SD or % with abnormal findings unless otherwise specified.

PFT Results	Never-smoking Patients with pSS, n = 27		Predicted Values, Absolute No.	p Values, Never-smoking pSS vs Predicted
	Absolute No.	% of Predicted		
VC, l	3.5 ± 0.9	96 ± 15	3.8 ± 1.0	0.060
TLC, l	5.8 ± 1.2	102 ± 11	5.6 ± 0.9	0.300
RV, l	2.2 ± 0.5	121 ± 19	1.9 ± 0.4	0.0001
RV/TLC ratio	0.39 ± 0.1	119 ± 20	0.34 ± 0.1	0.0001
FEV_1, l	2.5 ± 0.6	88 ± 14	2.9 ± 0.8	0.0001
FEV_1/VC ratio	0.72 ± 0.08	94 ± 8	0.76 ± 0.03	0.001
DLCO, mmol/min kPa	7.1 ± 1.9	102 ± 11	7.6 ± 1.9	0.065
DLCO, < 80% of predicted, n (%)	5/18	NA	NA	
COPD	30	NA	NA	
Mild	75	NA	NA	
Moderate	25	NA	NA	
Severe	0	NA	NA	
Clinically significant reversibility, n/%	0/0	NA	NA	

PFT: pulmonary function tests; pSS: primary Sjögren syndrome; FEV_1: forced expiratory volume in 1 s; VC: vital capacity; TLC: total lung capacity; RV: residual volume; COPD: chronic obstructive pulmonary disease; NA: not assessed.

The PFT of the patients with pSS mainly showed signs of obstructive pulmonary disease. The mean DLCO was decreased, which may be reduced in ILD, but also in emphysema. In both obstructive and restrictive pulmonary diseases, VC is decreased, but because TLC was normal and the RV/TLC ratio was increased in patients with pSS, there was no other sign of ILD. Taken together, the PFT findings suggest that obstructive rather than restrictive pulmonary disease dominates in pSS-associated pulmonary disease, although a minor superimposed restrictive pulmonary dysfunction cannot be excluded.

There was only a moderate correlation between PFT results and respiratory symptoms, assessed by SGRQ in our study. Unexpectedly, the symptom scores correlated inversely with TLC and DLCO, but not with FEV_1 or FEV_1/VC. The lack of correlation with FEV_1 or FEV_1/VC might be explained by the multiple reasons for respiratory symptoms in pSS, where such symptoms may be attributable to airway sicca, affecting virtually all patients, as well as airway obstruction and ILD. Another possible explanation might be that respiratory symptom scores reflect components of restrictive lung disease, because high respi-

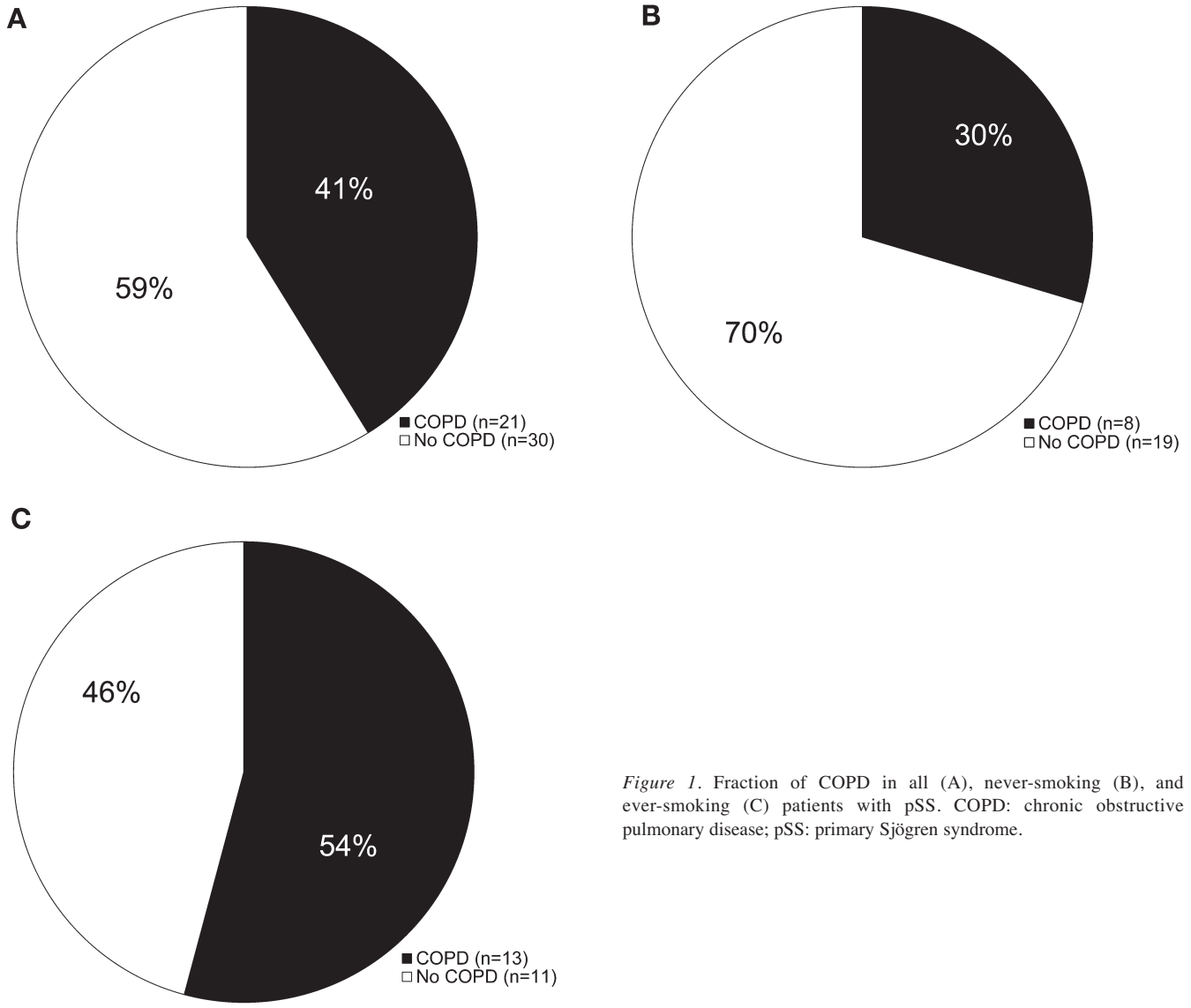

Figure 1. Fraction of COPD in all (A), never-smoking (B), and ever-smoking (C) patients with pSS. COPD: chronic obstructive pulmonary disease; pSS: primary Sjögren syndrome.

ratory symptom score were associated with lower TLC and DLCO. In the radiological evaluation, air trapping, a reticular pattern, bronchiectasis, and cysts were common, which is in accordance with previous studies[3,4,5,8,9,10,11,12,13], although a study identified radiographic ILD as the most frequent type of pulmonary finding among patients with pSS, followed by emphysema[26]. However, the radiographic findings can sometimes be difficult to interpret. A reticular pattern, often interpreted as a sign of ILD, might also derive from bronchial thickening and obstructive airway disease and thus be a sign of airway involvement, as previously suggested[10].

An increased mortality among patients with pSS with pulmonary involvement, including both obstructive and restrictive findings, has been proposed in 2 different studies[9,26]. In the retrospective study from Norway, a 4-fold increase in mortality over 10 years among patients with pSS with pulmonary involvement, defined as the presence of abnormal PFT results and/or HRCT findings, was reported[9]. The abnormal PFT signs in the mentioned study included an impaired DLCO, FEV_1, and forced VC, signs that could signify both obstructive and restrictive pulmonary disease, as discussed. Thus, obstructive airway disease may be associated with an increased mortality in patients with pSS, and early detection therefore is important, especially if better treatment options that prevent deterioration of pSS-associated pulmonary disease are available in the future[9]. Lacking such treatments, we propose that PFT be performed liberally in patients with pSS at baseline and followup. Further, we suggest that if symptomatic COPD is diagnosed, standard COPD treatment[18], including bronchodilators, possibly inhaled corticosteroids, and antibiotics, when indicated, should be started.

The strengths of our study were the use of consecutive

Table 3. Results of the ESSDAI respiratory domain and symptoms evaluated by the ESSPRI, and the SGRQ and radiographic findings of computed tomography of the chest in all the 51 patients with pSS, as well as patients with pSS with (+) and without (–) COPD. Radiographical signs of ILD represent traction bronchiectasis, ground glass attenuation, or honeycombing. Values are mean ± SD or % with abnormal findings unless otherwise specified.

Signs and symptoms	All Patients with pSS, n = 51	pSS + COPD, n = 21	pSS – COPD, n = 30	p, pSS + vs – COPD
ESSDAI respiratory domain score > 0	55	52	57	0.762
Low activity	39	38	40	0.891
Moderate activity	14	10	17	0.685
High activity	2	5	0	0.412
ESSPRI total score	6 ± 2	6 ± 3	6 ± 2	0.281
SGRQ total score	21 ± 16	24 ± 17	19 ± 16	0.232
SGRQ symptom score	27 ± 22	31 ± 20	24 ± 22	0.185
SGRQ activity score	33 ± 24	36 ± 27	31 ± 23	0.527
SGRQ impact score	13 ± 14	15 ± 15	11 ± 13	0.403
Radiographic findings				
Radiographic abnormalities	65	81	53	0.073
Air trapping	35	38	33	0.726
Reticular pattern	33	52	20	0.016
Central bronchiectasis	26	43	13	0.024
Traction bronchiectasis	8	5	10	0.634
Cysts	29	24	33	0.463
Emphysema	14	29	3	0.015
Ground glass attenuation	12	5	17	0.381
Honeycombing	0	0	0	NA
ILD signs	17	10	23	0.277

ESSDAI: EULAR Sjögren Disease Activity Index; ESSPRI: EULAR Sjögren Patient Reported Index; SGRQ: St. George's Respiratory Questionnaire; pSS: primary Sjögren syndrome; COPD: chronic obstructive pulmonary disease; ILD: interstitial lung disease; NA: not assessed; EULAR: European League Against Rheumatism.

patients with pSS, the use of the widely accepted AECG criteria, and the use of population-based controls in whom cigarette smoking was taken into account when comparing the PFT results.

One limitation of our study was the relatively small number of patients. Moreover, population-based controls for the SGRQ or the chest CT scans were not available. Further, CT of the chest is less sensitive in detecting radiographic pulmonary parenchymal abnormalities compared to HRCT, with a risk of underestimation of ILD, even though the frequency of observed pulmonary fibrosis using HRCT in our previous longitudinal study was low[8].

COPD in patients with pSS is a common finding, even among never-smoking patients. Signs of obstructive pulmonary disease form the predominant pattern, although a minor superimposed restrictive pulmonary disease cannot always be ruled out. The results suggest that pSS *per se* is involved in the development of COPD. Finally, we propose that PFT be performed liberally in patients with pSS, and if symptomatic COPD is diagnosed, standard COPD treatment should be started.

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Table 4. Disease characteristics and demographics, signs, and symptoms evaluated by the ESSPRI and the SGRQ; results of the PFT and radiographic findings in the 27 never-smoking and the 24 ever-smoking patients with pSS. Clinically significant reversibility was defined as FEV_1 improvement > 12% and > 200 ml. Radiographic signs of ILD represent traction bronchiectasis, ground glass attenuation, or honeycombing. Values are mean ± SD or % with abnormal findings unless otherwise specified.

Characteristics	Never-smoking pSS, n = 27	Ever-smoking pSS, n = 24	p, Never- vs Ever-smoking pSS
Age, yrs	58 ± 14	63 ± 10	0.227
Disease duration, yrs	19 ± 14	15 ± 10	0.321
Anti-SSA antibody seropositives	74	83	0.508
Anti-SSB antibody seropositives	33	63	0.037
IgG, g/l	13.5 ± 5.1	14.2 ± 5.2	0.624
C3, g/l	1.02 ± 0.26	1.04 ± 0.25	0.604
C4, g/l	0.17 ± 0.07	0.19 ± 0.07	0.395
Lower lip biopsy, focus score ≥ 1	85	58	0.058
ESSDAI total score	7 ± 7	7 ± 5	0.499
ESSPRI total score	6 ± 2	6 ± 2	0.681
SGRQ total score	20 ± 16	24 ± 17	0.365
PFT results			
VC, l	3.5 ± 0.9	3.1 ± 0.7	0.034
TLC, l	5.8 ± 1.2	5.4 ± 0.8	0.643
RV, l	2.2 ± 0.5	2.3 ± 0.4	0.389
FEV_1, l	2.5 ± 0.6	2.1 ± 0.6	0.009
FEV_1/VC ratio	0.72 ± 0.08	0.67 ± 0.08	0.026
DLCO, mmol/min kPa	7.1 ± 1.9	5.7 ± 1.6	0.013
COPD, n (%)	8 (30)	13 (54)	0.076
Clinically significant reversibility, n (%)	0 (0)	2 (8)	0.216
Radiographic findings			
Radiographic abnormalities, any of the below	60	71	0.388
Air trapping	37	33	0.782
Reticular pattern	22	46	0.074
Central bronchiectasis	19	33	0.226
Traction bronchiectasis	15	0	0.113
Cysts	26	33	0.562
Emphysema	8	21	0.232
Ground glass attenuation	15	8	0.671
Honeycombing	0	0	NA
ILD signs	26	8	0.147

ESSPRI: EULAR Sjögren Patient Reported Index; SGRQ: St. George's Respiratory Questionnaire; PFT: pulmonary function tests; pSS: primary Sjögren syndrome; FEV_1: forced expiratory volume in 1 s; ILD: interstitial lung disease; IgG: immunoglobulin G; C3: complement factor 3; C4: complement factor 4; ESSDAI: EULAR Sjögren Disease Activity Index; VC: vital capacity; TLC: total lung capacity; RV: residual volume; COPD: chronic obstructive pulmonary disease; NA: not assessed; EULAR: European League Against Rheumatism.

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