Original Article

Evaluation of symptoms and risks in stable chronic obstructive pulmonary disease patients with radiographic bronchiectasis

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Abstract

Objective: To investigate the presence of previously undiagnosed radiographic bronchiectasis in stable chronic obstructive pulmonary disease (COPD) patients using high resolution computed tomography (HRCT) and to evaluate the effect of radiographic bronchiectasis on the symptoms and risks in stable COPD patients.

Methods: From May 2012 to April 2014, there were 347 patients enrolled in COPD database. Data describing the general conditions, the frequency of acute exacerbations the year before, COPD assessment test, modified medical research council (mMRC) score, spirometric classification, and HRCT were collected. COPD patients were classified into two groups: COPD with bronchiectasis and COPD without bronchiectasis. The clinical characteristics of both groups were compared.

Results: Bronchiectasis was presented in 18.4% ($n = 64$). The proportion of smokers, smoking index, and forced expiratory volume in 1 second predicted value were 62.5%, 27.3 ± 13.2, 48.2 ± 26.4, respectively, in the bronchiectasis group, which were lower than those of the group without bronchiectasis (82.0%, 32.6 ± 17.6, and 57.9 ± 18.8) ($P < 0.05$). Complications, COPD assessment test (CAT) and the rate of CAT ≥ 10 in the bronchiectasis group were 2.8 ± 1.7, 13.6 ± 7.4 and 26.6%, respectively, which were higher than those of the group without bronchiectasis (2.3 ± 1.5, 11.3 ± 6.0, and 11.7%) ($P < 0.05$). The proportion of type D (high-risk more-symptoms) in the bronchiectasis group was 50.0%; it was significantly higher than that of 35.7% in the group without bronchiectasis ($P < 0.05$).

Conclusions: COPD with bronchiectasis is associated with more complications, symptoms, and risks. More attention should be paid to the treatment of COPD with bronchiectasis to reduce the frequency of exacerbation and improve the health status.

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Keywords: Bronchiectasis; Chronic obstructive pulmonary disease; Combined assessment; High resolution computed tomography; Symptoms and risk

Introduction

In recent years, chronic obstructive pulmonary disease (COPD) is being gradually recognized as a systemic disease.[1,2] With the extensive use of high-resolution computed tomography (HRCT), radiographic bronchiectasis, which could not be identified in the past, is

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being diagnosed.[3] Research has shown that radiographic bronchiectasis can prolong the duration of the episodes of acute exacerbation of COPD[4] and increase the mortality.[5] Therefore, radiographic bronchiectasis was listed as one of the comorbidities of COPD in the Global Initiative for Chronic Obstructive Lung Disease (GOLD) 2014 for the first time.[1] However, the incidence rate (4−50%) of COPD complicated with radiographic bronchiectasis varies considerably in different studies.[3,4,6,7] This indicates that the incidence of radiographic bronchiectasis may be related to the severity level of airflow limitation. However, there are few reports till date on the comprehensive evaluation of symptoms and risks in COPD patients with radiographic bronchiectasis. This study was designed, through a comprehensive evaluation of patients with stable COPD complicated with radiographic bronchiectasis, to investigate the incidence of radiographic bronchiectasis in patients with different subtypes of COPD and its effects on stable COPD patients. Results of this study will also provide valuable information for the better control of COPD progression.

Methods

Study population

A total of 461 patients who attended the COPD outpatient clinic of our hospital from May 2012 to April 2014, with established disease archives, were enrolled in this survey. All recruited patients complied with the COPD diagnostic criteria that is, the ratio of the forced expiratory volume in 1 s to the forced vital capacity (FEV_1/FVC) should be less than 70% following bronchodilator inhalation, and were stable at the time of the test. The exclusion criteria were as follows: (1) concomitant classical bronchiectasis, active tuberculosis, bronchial asthma or pulmonary interstitial fibrosis with definite and typical clinical symptoms; (2) concomitant serious cardiac, cerebral, hepatic or renal insufficiency; (3) inability to read and answer the questionnaire independently.

Measurements

A face-to-face survey was conducted for all enrolled patients between May 2012 and April 2014, in the outpatient clinic of the pulmonary department, Peking University People's Hospital.[8] The patient history and symptoms were evaluated, and physical examination were conducted by medical professionals. The survey recorded data such as demographic characteristics, presence of complications, smoking status, and the number of exacerbations of COPD within the previous 12 months. The COPD assessment test (CAT) and modified medical research council (mMRC) questionnaires were completed by patients after receiving appropriate guidance from a physician.[9,10]

Lung function and bronchodilation test were performed using a fully automatic pulmonary function analyzer (Master Screen-PFT, CareFusion Germany 234 GmbH, Leibnizstrasse 7-97204 HoechbergJaeger®, Germany). For all patients who accepted pulmonary HRCT test, radiographic bronchiectasis analysis was performed by radiologists using HRCT test to determine presence of bronchiectasis.[11] Depending on the morphological characteristics cystic, cylindrical and thick- and thin-walled bronchiectactic areas were identified.[12−15] All patients with COPD were divided into a bronchiectasis group or a "without bronchiectasis" group based on the presence of HRCT-verified bronchiectasis.

Based on the symptoms, lung function tests, and risk of acute exacerbation of chronic obstructive pulmonary disease (AECOPD), patients were classified into four types: low-risk fewer-symptoms (Type A), low-risk more-symptoms (Type B), high-risk fewer-symptoms (Type C), and high-risk more-symptoms (Type D).

Statistical analysis

A database was created using EpiData (version 3.1 freeware from http://www.epidata.dk), and the double-entry method was adopted for quality control. For statistic analysis, SPSS 18.0 (SPSS Inc., Chicago, IL, USA) was used. Continuous variables were represented as mean ± standard deviation (SD). Categorical variables were expressed as numbers (%) and contingency tables and χ^2 tests were used for comparing the numerical data. One-way analysis of variance (ANOVA) was employed for inter-group comparison of the data with the significance level α set at 0.05.

Results

Of the 461 COPD patients identified, 347 patients had undergone HRCT examination. The remaining 114 patients only had the results of chest X-ray alone. Therefore, 347 patients were included in the primary analysis. Comparison of the baseline data from the archives of recruited and non-recruited patients showed no significant differences in terms of age, body mass index, smoking index, FEV_1/FVC % in both groups ($P = 0.485-0.523$). Males accounted for 87.3% of the recruited patients; this was higher than the proportion in the unselected patients ($\chi^2 = 7.98$, $P = 0.005$). The

FEV_1 % predicted value of recruited patients was 56.2 ± 20.7; this was lower than that of non-recruited patients ($t = 2.36$, $P = 0.019$) (Table 1).

HRCT showed concomitant radiographic bronchiectasis in 64 (18.4%) of the 347 patients. Cylindrical bronchiectasis, cystic bronchiectasis, left-lung bronchiectasis, right-lung bronchiectasis, double-lung bronchiectasis, thin-walled bronchiectasis and thick-walled bronchiectasis were presented in 67.2% (43/64), 28.1% (18/64), 25% (16/64), 15.6% (10/64), 59.4% (38/64), 57.8% (37/64) and 42.2% (27/64) of the 64 patients, respectively.

A comparison of the comprehensive clinical evaluation results of the bronchiectasis group and the group without bronchiectasis showed the proportion of smokers, smoking index, and FEV_1 were lower in the bronchiectasis group than in the group without bronchiectasis ($t = 2.20−2.64$, $\chi^2 = 11.69$, $P = 0.001−0.01$). The number of complications, the CAT score, and the proportion of patients with CAT ≥ 10 were higher in the bronchiectasis group than in the group without bronchiectasis ($t = 2.13−2.28$, $\chi^2 = 9.40$, $P = 0.002−0.034$). Comprehensive clinical evaluation showed no statistically significant differences in the proportions of types A, B, and C between the two groups ($\chi^2 = 0.03−2.32$, $P = 0.128−0.861$). The proportions of type D was higher in the bronchiectasis group (50%) than in the group without bronchiectasis (35.7%), and the difference was statistically significant ($\chi^2 = 4.52$, $P = 0.033$) (Table 2).

Discussion

Classic bronchiectasis is a well-known entity.[14] In recent years, with the widespread use of chest HRCT, many subclinical radiological changes have been detected, one of which is called radiographic bronchiectasis. Classic bronchiectasis and radiographic bronchiectasis pertain to the same kind of anatomo-pathological changes and have similar radiographic appearances. Bronchiectasis was not included among the comorbidities of COPD patients in GOLD 2011 or GOLD 2013.[14−16] The GOLD 2014 amendment clearly pointed out that COPD complications should include bronchiectasis, which mainly refers to radiographic bronchiectasis. However, the effects of radiographic bronchiectasis on the assessment of disease condition, risk of future attacks of AECOPD, and prognosis of COPD have not been described. Therefore, an in-depth study on this issue is necessary.

The data in Table 2 show that, the mMRC scores and the proportion of patients with CAT ≥ 10 in the bronchiectasis group were significantly higher than those in the group without bronchiectasis. The results of this study indicated that co-existed radiographic bronchiectasis can significantly influence the severity of the clinical symptoms of COPD patients. If the smoking factor is adjusted for, the symptom scores in the two groups may differ more significantly. More complications were found in the bronchiectasis group than in the group without bronchiectasis. Although the mechanism is unclear, it is certain that radiographic bronchiectasis can affect the severity and prognosis of COPD patients. The data in Table 2 indicate that the FEV_1 % predicted value of the bronchiectasis group was significantly lower than that of the group without bronchiectasis although the percentage of smokers and the smoking index in the without bronchiectasis group were significantly higher than in the bronchiectasis group. This may further demonstrate that the disease severity in the bronchiectasis group may be greater than that in the group without bronchiectasis. More importantly, this may indicate that the future risk of AECOPD in COPD patients may be significantly higher in the bronchiectasis group than that in the group without bronchiectasis. This has important significance in the prediction and prevention of AECOPD.

What were interested in is whether the symptoms of concomitant radiographic bronchiectasis can also affect the COPD disease grouping. The results

Table 1
Comparison of the baseline data of recruited and non-recruited patients.

Group	n	Age, years	Male, %	BMI, kg/m^2	Smoking index, pack/year	Predicted FEV_1, %	FEV_1/FVC, %
Recruited	347	71.4 ± 9.7	87.3	23.7 ± 3.5	31.8 ± 17.1	56.2 ± 20.7	56.0 ± 11.3
Non-recruited	114	70.8 ± 9.7	76.3	23.9 ± 3.7	33.3 ± 19.1	61.5 ± 17.0	56.9 ± 12.0
t/χ^2 value		0.64[a]	7.98[b]	0.70[a]	0.70[a]	2.36[a]	0.69[a]
P value		0.523	0.005	0.487	0.485	0.019	0.490

BMI: body mass index; FEV_1: forced expiratory volume in 1 s; FVC: forced vital capacity.
All numbers shown are mean ± standard deviation unless otherwise specified as number (%).
[a] t test, measurement data.
[b] χ^2 test, categorical variable.

Table 2
Comparison of comprehensive clinical evaluation results of the bronchiectasis group and the group without bronchiectasis.

Characteristics	Group without bronchiectasis ($n = 283$)	Bronchiectasis group ($n = 64$)	t/χ^2 value	P value
Age, years	71.5 ± 9.7	71.4 ± 10.0	0.03[a]	0.973
Male, %	88.7	81.3	2.61[b]	0.106
BMI, kg/m^2	23.6 ± 1.5	23.9 ± 3.3	0.48[a]	0.631
Smoking, %	82.0	62.5	11.69[b]	0.001
Smoking index, packs/year	32.6 ± 17.6	27.3 ± 13.2	2.20[a]	0.030
Number of complications	2.3 ± 1.5	2.8 ± 1.7	2.13[a]	0.034
FEV$_1$ % predicted	57.9 ± 18.8	48.2 ± 26.4	2.64[a]	0.010
FEV$_1$/FVC (%)	56.0 ± 11.3	56.1 ± 11.7	0.08[a]	0.934
Pulmonary function severity scale, %				
Grade I	12.4	7.8	0.98[b]	0.321
Grade II	51.9	48.4	0.39[b]	0.530
Grade III	29.0	31.3	0.173[b]	0.677
Grade IV	6.7	12.5	2.73[b]	0.098
Number of acute exacerbations the year before the survey	0.9 ± 1.1	1.1 ± 1.3	1.16[a]	0.246
Proportion of acute exacerbations $\geq$ twice/year, %	23.0	31.3	1.94[b]	0.164
CAT score	11.3 ± 6.0	13.6 ± 7.4	2.28[a]	0.025
Proportion of CAT $\geq$ 10, %	11.7	26.6	9.40[b]	0.002
mMRC (grade)	1.5 ± 1.0	1.7 ± 0.9	0.98[a]	0.327
Proportion of mMRC score $\geq$ grade 2, %	49.1	54.7	0.648[b]	0.421
Proportion of COPD type, %				
Type A	33.2	23.4	2.32[b]	0.128
Type B	23.0	21.9	0.03[b]	0.861
Type C	8.1	4.7	0.89[b]	0.345
Type D	35.7	50.0	4.52[b]	0.033

BMI: body mass index; FEV$_1$: forced expiratory volume in 1 s; FVC: forced vital capacity; COPD: chronic obstructive pulmonary disease; CAT: COPD assessment test; mMRC: modified medical research council.
All numbers shown are mean $\pm$ standard deviation unless otherwise specified as number (%).
[a] t test, measurement data.
[b] χ^2 test, categorical variable.

indicated that the percentage of type D patients in the bronchiectasis group was significantly higher than that in the group without bronchiectasis. This has important clinical significance. The grouping into A, B, C, and D is mainly used for guiding the establishment of clinical treatment principles and regimens, hence even when there are no significant clinical symptoms and signs in those patients with radiographic bronchiectasis, the co-existence of radiographic bronchiectasis with COPD has important clinical significance.

Nevertheless, this study also has some limitations. Among the 461 patients with established archives of disease in the COPD clinic, only 347 patients had undergone HRCT examination. The proportion of males among the recruited patients was higher than that among the non-recruited patients, and the FEV$_1$ % predicted value was lower than that in the non-recruited patients. Small cylindrical bronchiectasis in only one single pulmonary segment is common in healthy adults.[17] The effects of different severities of bronchiectasis on COPD symptoms and risks need to be studied further. In spite of this, we believe that the

co-existence of radiographic bronchiectasis has important significance in the COPD assessment for evaluating the future risk, and determining the clinical treatment. A chest HRCT is recommended whenever possible to determine the co-existence of radiographic bronchiectasis in COPD patients.

Conflicts of interest

The authors declare that they have no conflict of interest.

Acknowledgements

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