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CASE REPORT

Hypersensitivity Pneumonitis and Bronchial Asthma Attacks Caused by Environmental Fungi

Nobuyuki Katayama[1], Masaki Fujimura[1], Masahide Yasui[1], Haruhiko Ogawa[1] and Shinji Nakao[1]

ABSTRACT

We report a case of hypersensitivity pneumonitis and asthma attacks caused by environmental fungi in a 75-year-old man. The diagnosis was established by inhalation challenge with *Bjerkandera adusta* and *Aspergillus fumigatus*. The patient was admitted for treatment of fever, wheezing, and dyspnea. Chest computed tomography showed small nodular shadows with diffuse, partially patchy, ground-glass opacities. The findings of bronchoalveolar lavage fluid were compatible with hypersensitivity pneumonitis. His symptoms and objective findings, including chest radiographs, worsened after returning home, suggesting the existence of causative antigens in his house. *B. adusta* and *A. fumigatus* were isolated from the living room and bedroom. Based on the results of antigen inhalation bronchoprovocation test, he was given a diagnosis of hypersensitivity pneumonitis caused by *B. adusta* and bronchial asthma attacks caused by *B. adusta* and *A. fumigatus*. After cleaning the entire house, the patient has had no recurrence of the symptoms on returning home.

KEY WORDS

Bjerkandera adusta, bronchial asthma, home environment provocation test, hypersensitivity pneumonitis, inhalation challenge test

INTRODUCTION

Hypersensitivity pneumonia (HP) is an interstitial lung disease characterized by an abnormal immunologic reaction to specific antigens contained in a wide variety of organic dust. Summer-type hypersensitivity pneumonia (SHP) is one of the most common types of HP in Japan.[1] Most cases of SHP in Japan are caused by inhalation of *Trichosporon cutaneum*, a fungus that grows copiously in the house during the humid summer after the rainy season.[2] Other types of fungi, for example *Penicillium*[3] and *Fusarium*,[4] also have been reported as causes of HP. Bronchial asthma is an allergic disease, and inhalation of fungal antigens causes asthma attacks in some patients. We report here a case of HP and asthma attacks caused by an environmental fungus, *Bjerkandera adusta*, which was diagnosed by antigen inhalation challenge.

CLINICAL SUMMARY

A 75-year-old man was admitted to Kanazawa University Hospital on 29 March 2006 because of dyspnea, productive cough, fever, and wheezing. He had previously received outpatient treatment for bronchial asthma, sinobronchial syndrome, and yellow nail syndrome. He had been hospitalized six times since the age of 50 for the treatment of pneumonia. In January 2004, he had been admitted because of fever and dyspnea. Chronic eosinophilic pneumonia was diagnosed on bronchoalveolar lavage fluid (BALF) and other findings. Corticosteroid therapy was started and tapered off gradually until September 2005. The patient had no history of smoking or dust exposure. He lived in a 30-year-old wooden house. No pets were kept in his house.

Physical examination revealed the following findings: temperature 38.6℃, blood pressure 90/58 mmHg, and pulse rate 84 beats/min. Findings on cardiac examination were entirely within normal limits. Respiratory rate was 26 times/min. Auscultation of the lungs revealed holo-inspiratory and expiratory rhonchi in all lung fields.

[1]Respiratory Medicine, Kanazawa University Hospital, Ishikawa, Japan.
Correspondence: Nobuyuki Katayama, Respiratory Medicine, Kanazawa University Hospital, 13–1 Takara-machi, Kanazawa, Ishikawa 920–8641, Japan.
Email: katayama@med3.m.kanazawa–u.ac.jp
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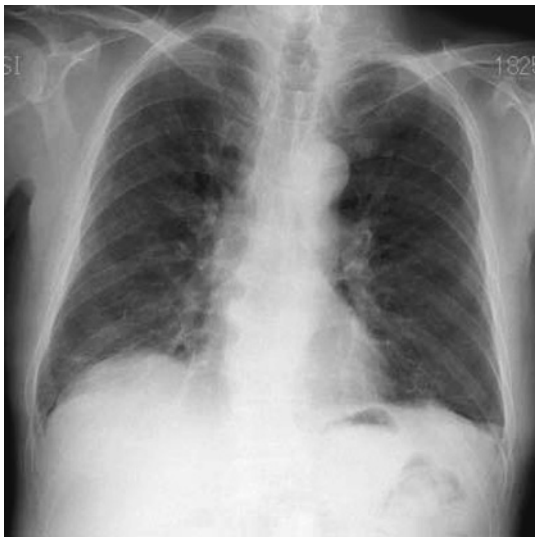

Fig. 1 Chest radiograph on admission showing small nodules, linear shadows, and band-shaped shadows with an increase in lung density predominantly in both lower fields.

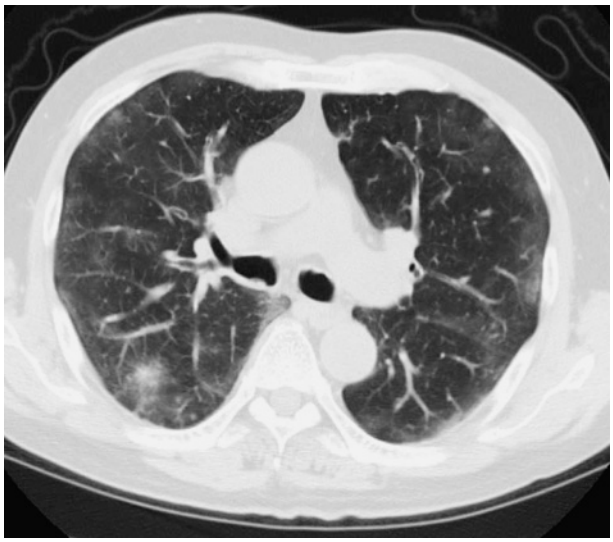

Fig. 2 Chest computed tomography scan on admission showing small nodular shadows with diffuse, partially patchy, ground-glass opacities.

The white blood cell count was 22,700 cells/μL with a differential of 73.0% neutrophils, 16.0% lymphocytes, 9.0% monocytes, and 1.0% eosinophils. The erythrocyte sedimentation rate was 77 mm/h. The C-reactive protein level was 1.1 mg/dL. Arterial blood gas analysis showed pH 7.494, $PaCO_2$ 35.4 torr, and PaO_2 51.2 torr. The total IgE, KL-6, SP-D, and other laboratory findings were normal or negative. Cultures for microorganisms from the patient's sputum grew normal flora. The chest radiograph on admission showed small nodules, linear shadows, and band-shaped shadows with an increase in lung density predominantly in both lower fields (Fig. 1). The chest computed tomography scan showed small nodular shadows with diffuse, partially patchy, ground-glass opacities (Fig. 2).

Because of concerns that the patient might have atypical pneumonia, for example, Legionella pneumonia, concurrent with an asthma attack, we began the treatment with antibiotics (quinolone) and bronchodilators. The patient's symptoms and objective findings improved smoothly and he was discharged on 7 April. However, 3 days later, on 10 April, he was readmitted for recurrence of cough, wheezing, and dyspnea. The objective findings this time were very similar to those from the last admission. He promptly improved following treatment with 20 mg/day prednisolone for the asthma attack. We now suspected that the patient must be suffering from HP, and a home environment provocation test was done on 21 April. Approximately 20 hours after he returned home, his illness was reproduced. This time his symptoms and laboratory and radiological findings improved following hospitalization, only, without medication. Differential cell analysis of BALF, taken after the home provocation test, revealed 22.5% alveolar macrophages, 64.0% lymphocytes, 11.5% neutrophils, 2.0% eosinophils, and an increased total cell count of 3.3×10^5. These findings strongly suggested the diagnosis of HP.

Sterile Petri dishes containing Sabouraud's agar medium supplemented with antibiotics were exposed for 10 minutes on the floor of every room of the patient's house with the windows closed, and *Aspergillus fumigatus* and *B. adusta* were isolated from the dishes exposed in the living room and bedroom.

Skin tests for fungal antigens were done by intradermal injection with 0.02 ml of the solutions (1 mg/ml). The immediate-type and late-type skin test reactions for *A. fumigatus* and *B. adusta* were negative. The specific IgE for *Aspergillus* was positive.

Bronchoprovocation test using 2 ml of the fungal antigen solutions (1 mg/ml) was performed after the patient gave informed consent. We confirmed that endotoxin was not contained in the antigen. The control solution did not induce any abnormal findings. However, *A. fumigatus* antigen inhalation caused wheezing and decrease in FEV_1, whereas it was judged to be negative for provocation of HP. *B. adusta* antigen inhalation revealed wheezing, decreased FEV_1, deterioration of SpO_2 to 93%, 1℃ increase in body temperature, and increased numbers of white blood cells in the peripheral blood (Table1). We judged that *B. adusta* was the antigen causing both asthma and HP. Based on these results, the patient thoroughly cleaned the entire house, and he has not experienced further exacerbations since the cleaning.

Table 1 Clinical and laboratory findings of the antigen inhalation challenge test using antigen extract solutions of *Aspergillus fumigatus* and *Bjerkandera adusta*

Antigen	Clinical and laboratory findings	Before	10 min	Bronchodilator	1 h	6 h	24 h
Aspergillus fumigatus	Body temperature (℃)	36.2	36.3	36.2	36.5	36.1	35.8
	Symptoms	—	Dyspnea	—	—	—	—
	Auscultation of the lungs	Normal	Wheezes	Normal	Normal	Normal	Normal
	WBC (/μL)	7700					7700
	CRP (mg/dL)	0.1					0.2
	FVC (L)	3.12	3.02	3.10	3.10	3.08	3.10
	FEV_1 (L)	1.52	1.26	1.43	1.43	1.43	1.44
	SpO_2 (%)	97	97	97	97	97	97
Bjerkandera adusta	Body temperature (℃)	35.9	36.6	36.5	36.4	36.9	35.7
	Symptoms	—	Dyspnea	—	—	—	—
	Auscultation of the lungs	Normal	Wheezes	Normal	Normal	Normal	Normal
	WBC (/μL)	8600					9300
	CRP (mg/dL)	0.1					0.1
	FVC (L)	2.98	2.90	3.00	3.08	3.10	3.06
	FEV_1 (L)	1.43	1.11	1.43	1.53	1.58	1.44
	SpO_2 (%)	97	97	96	93	95	97

DISCUSSION

Fungi are among the most important antigens for HP. For example, *T. cutaneum* is the principal antigen linked to summer-type HP, one of the most prevalent types of HP in Japan.[1] Many other fungi have also been reported as causative antigens for HP. Some of these are encountered through occupational exposure[5] and others through environmental exposure.[1,3,4,6,7] Generally, it is very difficult to detect the antigen, especially in the case of environmental exposure. In some patients, bronchial asthma also is caused by inhalation of fungal antigens, and some cases of asthma are linked with a particular fungus, as in allergic bronchopulmonary aspergillosis.

Fungi comprise more than 72,000 species. Some of them are known pathogens, but large numbers of fungi cause disease via an allergic mechanism. *B. adusta* is a white rot saprophyte belonging to filamentous basidiomycetes fungi. It grows mainly on dead trees in fields and mountains and is distributed broadly around the world. It is noted for its ability to make alcohol and other substances from plants.[8] In previous reports, *B. adusta* was shown to be present in sputum, bronchial lavage fluid, and lung tissue,[9] but the assessment of its pathogenicity has been difficult.

In the present case, we were able to obtain the following evidence: the *B. adusta* was isolated from the house of the patient, the home provocation test upon the patient's return was positive, and the inhalation bronchoprovocation test was positive for *B. adusta* antigen. Based on these findings, the patient was given a diagnosis of HP caused by *B. adusta* antigen and was successfully treated by reducing the exposure. On the other hand, it was proved by the bronchoprovocation test that *B. adusta* and *A. fumigatus* were antigens inducing asthma attacks in this patient. In considering the patient's history and these findings, we suspect that eosinophilic pneumonia, diagnosed in 2004, may have been related to inhalation of these environmental fungi. Cases of eosinophilic pneumonia caused by fungal antigens have also been reported.[10,11] This case emphasizes the importance of an environmental survey and antigen inhalation bronchoprovocation testing to detect causative antigens in allergic lung diseases.

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Written informed consent was obtained from the patient.

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