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【 CASE REPORT 】

Bronchodilator Reversibility Occurring during the Acute Phase of *Paragonimiasis westermani* Infection

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Abstract:

A 43-year-old woman was referred to our hospital with peripheral blood hypereosinophilia and abnormal chest X-ray findings. Her pleural effusion revealed hypereosinophilia and a low glucose level. She was diagnosed with pulmonary paragonimiasis based on an elevated antibody level of *Paragonimiasis westermani*. Although she had no medical history of allergic disorders, a pulmonary function test revealed bronchodilator reversibility. After praziquantel therapy, her symptoms, hypereosinophilia in peripheral blood, and pleural effusion were improved. A repeated pulmonary function test after praziquantel therapy showed a negative bronchodilator response. Pulmonary paragonimiasis may induce bronchodilator reversibility during the acute phase of infection.

Key words: *Paragonimiasis westermani*, pulmonary paragonimiasis, bronchodilator reversibility, asthma, eosinophil

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Introduction

Peripheral blood eosinophilia and eosinophilic pleural effusion are caused by various conditions, including allergic diseases, infectious diseases such as mycobacterial infection and parasitic diseases, autoimmune diseases, and malignant tumors. Pulmonary paragonimiasis is a parasitic disease associated with a high frequency of eosinophilic pleural effusion. Asthma is characterized by bronchial hyperresponsiveness, reversible airway constriction, and chronic airway inflammation caused by eosinophils. Bronchodilator reversibility is one of the characteristics of bronchial asthma. However, to our knowledge, bronchodilator reversibility in the context of allergic reaction induced by pulmonary paragonimiasis has not been reported.

We herein report a patient with *Paragonimiasis westermani* infection who presented with peripheral blood eosinophilia and eosinophilic pleural effusion and in whom a pulmonary function test revealed bronchodilator reversibility. After treatment with praziquantel, the bronchodilator reversibility was improved.

Case Report

A 43-year-old woman was referred to our hospital with left-sided chest pain, peripheral blood hypereosinophilia, and abnormal chest X-ray findings. She was admitted to our hospital for a further examination and treatment. She had no significant medical history including that of allergic disorders, such as asthma and allergic rhinitis; her family history was also unremarkable. She occasionally ate raw boar meat that had been hunted by her husband.

On admission, her body temperature was 36.8°C, blood pressure was 116/74 mmHg, pulse rate was 82 beats/min, and oxygen saturation was 99% in room air. No crackles were heard in either lung field. Her total white blood cell count was 17,100/μL (neutrophils 19.4%, lymphocytes 13.0%, eosinophils 63.3%). Her serum total immunoglobulin E level was 3,575 IU/mL, C reactive protein level 0.04 mg/dL, erythrocyte sedimentation rate 9 mm/h, rheumatoid factor level 5 IU/L, immunoglobulin G level 1,607 mg/dL, im-

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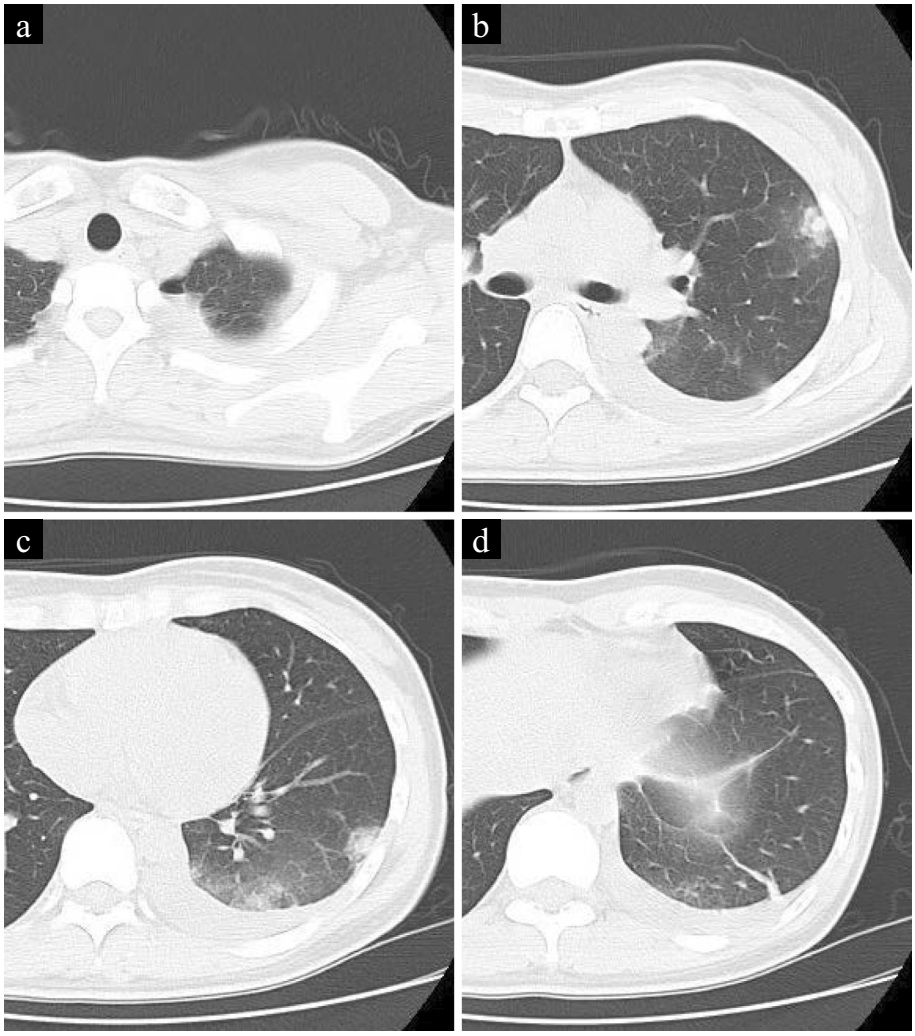

Figure 1. Chest CT at admission. (a) Pneumothorax and pleural effusion are observed in the left lung field. (b, c) Pulmonary infiltrates are observed in left upper and lower lobe. (d) Linear opacity is also observed in the left lower lobe.

munoglobulin A level 266 mg/dL, immunoglobulin M level 181 mg/dL, myeloperoxidase-anti neutrophil cytoplasmic antibodies (MPO-ANCA) <0.5 U/mL, and proteinase 3-anti neutrophil cytoplasmic antibodies (PR3-ANCA) <0.5 U/mL. The results of allergen-specific immunoglobulin E were as follows: cedar, 23.07 IU/mL and cypress, 6.64 IU/mL.

Chest computed tomography (CT) showed consolidation at the peripheral lung field in the left upper and lower lobes, hydropneumothorax, and linear opacity in the left lung field (Fig. 1). A pleural fluid analysis revealed an elevated eosinophil count (99%), lactate dehydrogenase (LDH) level of 799 IU/L, adenosine deaminase (ADA) level of 30.7 U/L, glucose level of 1 mg/dL, and total protein level of 5.8 g/dL. Bacteriological and cytological examinations of left pleural effusion and a cytological examination of the sputum were negative. The proportion of eosinophils in the sputum was less than 1%. Based on the CT findings of hydropneumothorax, the marked elevation of the eosinophil count in both the pleural effusion and peripheral blood, and the history of ingestion of wild boar meat, a diagnosis of pulmonary paragonimiasis was suspected.

The diagnosis was finally confirmed by a high titer of serum anti *P. westermani* IgG antibody detected by a microplate enzyme-linked immunosorbent assay (ELISA). We also performed spirometry and examined the bronchodilator reversibility at the time of her admission. Her forced expiratory volume in 1 second (FEV1) was 2.71 L, and her forced vital capacity (FVC) was 3.31 L before inhalation of a bronchodilator. After inhalation of 20 μg of procaterol, her FEV1 increased to 400 mL (14.7%), and her FVC increased to 200 mL, which is considered to be a positive bronchodilator response (Fig. 2a and b). Her dyspnea was improved after inhalation of a bronchodilator.

She was treated with oral praziquantel therapy (75 mg per kg per day). However, the treatment was discontinued on the second day due to the development of drug eruption. After 1 month, her peripheral blood eosinophilia was improved, and her immunoglobulin E level was 4,814 IU/mL. Chest CT showed the resolution of consolidation and pleural effusion. Repeat spirometry was performed after one month of oral praziquantel therapy; her FEV1 prior to bronchodilator inhalation improved to 3.38 L, and her FEV1 only increased to

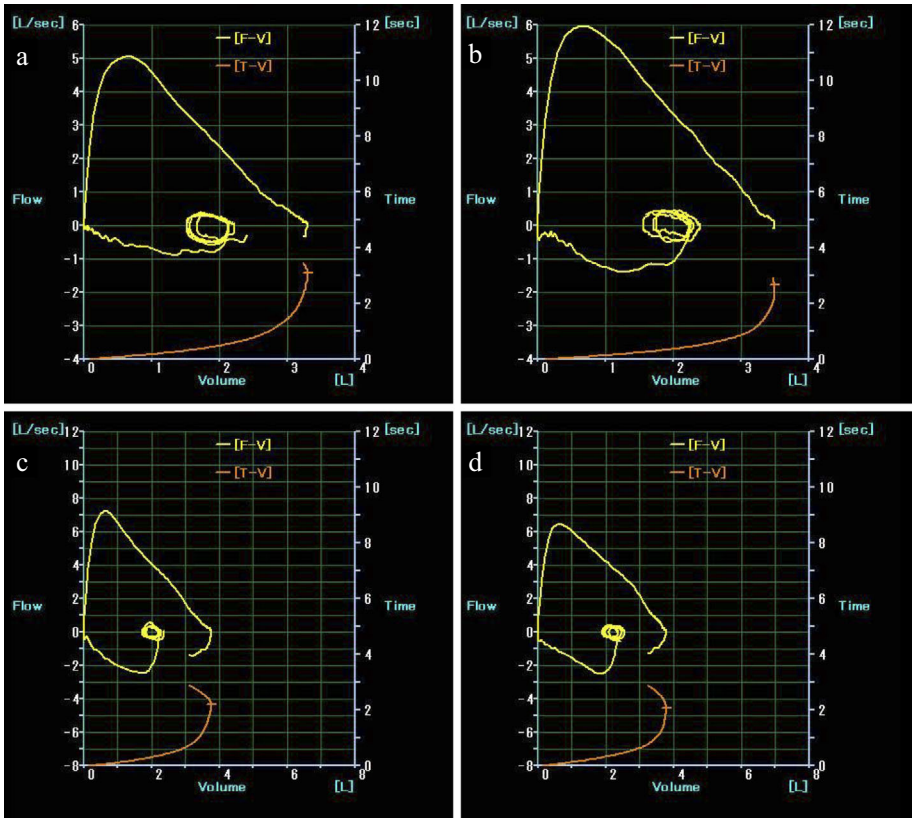

Figure 2. **Spirometry performed prior to treatment of pulmonary paragonimiasis showed bronchodilator reversibility. (a) FEV1 and FVC prior to bronchodilator inhalation were 2.71 and 3.31 L, respectively. (b) FEV1 and FVC after bronchodilator inhalation were 3.11 and 3.51 L, respectively. Bronchodilator reversibility was improved after treatment of pulmonary paragonimiasis. (c) FEV1 and FVC prior to bronchodilator inhalation were 3.38 and 3.77 L, respectively. (d) FEV1 and FVC after bronchodilator inhalation were 3.46 and 3.80 L, respectively.**

80 mL (2.3%) after bronchodilator inhalation (Fig. 2c and d).

Discussion

Pulmonary paragonimiasis is an endemic zoonosis in Asia caused by the ingestion of raw or undercooked freshwater crab or boar meat infected with metacercaria. Of late, paragonimiasis has been less frequently reported in Japan, with approximately 30 patients diagnosed each year (1). *P. westermani* is associated with diverse radiological findings, such as pneumothorax, nodular shadow, pleural effusion, and pleural thickening (1). The worm migration tract is a characteristic feature and of great diagnostic value (2).

Although cases of hydropneumothorax are on record, eosinophilic pleural effusion is a characteristic feature of paragonimiasis. In paragonimiasis, an examination of the pleural effusate typically shows eosinophilia, low glucose levels, and high lactate dehydrogenase levels (3). The increase in the number of eosinophils in the pleural fluid is attributable to the increased production of cytokines, such as IL-5 by Th2 cells, the thymus, and also to the enhanced activation of chemokines (4, 5). A microscopic demonstration of parasite eggs in the sputum or bronchoalveolar lavage fluid is the gold standard for diagnosing pulmonary paragonimiasis. However, the detection rate of parasite eggs is typically low. A microplate ELISA analysis has been shown to be a highly sensitive serological test and is the main diagnostic approach in current clinical practice (1).

The occurrence of bronchodilator reversibility in a case of *P. westermani* infection has not been reported thus far. Bronchodilator reversibility is a feature of allergic reaction and is observed in patients with asthma and chronic obstructive lung disease. Agatsuma et al. reported the histopathological findings of Wistar rats infected with *P. westermani* (6). In the present study, the infiltration of mast cells and eosinophils was observed at the site of pleuritis and lung inflammation as early as 18 days after infection. At the same time, thickened bronchial mucosa, increased goblet cells, thickened basement membrane, and hypertrophy of the bronchial smooth muscle were also observed. Thirty-five days after infection, Charcot-Leyden crystals were recognized. These findings are analogous to histopathological findings of asthma. Mast cells release irritants, such as histamine, which stimulate the bronchial mucosa. Bronchial inflammation is associated with bronchial hyperresponsiveness, which is a hallmark of asthma. Evidence of a Th2-dominant immunological response has been documented in patients with *P.*

westermani infection (7).

In the presence of pneumothorax and pleural effusion, spirometry showed a reduction in the FVC and FEV1, as these conditions compress the lung parenchyma and displace the thoracic cage outwards. Cartaxo et al. reported the pulmonary function results before and after the removal of pleural effusion (8). After thoracentesis, they cited an increase of 350 mL in the FVC and of 280 mL in the FEV1. The mean amount of fluid removed was 1,564 mL. Spyratos et al. and Michaelides et al. reported similar results and no correlation between the spirometric results and the volume of aspirated fluid (9, 10). Gilmartin et al. reported the influence of pneumothorax on the pulmonary function (11). There was relationship between the size of the pneumothorax and the changes in the spirometric results. In our case, the increase in the FVC and FEV1 during the recovery phase might have been due in part to the influence of pleural effusion and pneumothorax. However, the patient's symptoms were improved after inhalation of a bronchodilator, which is considered to be a positive bronchodilator response.

In conclusion, this is the first documented case of *P. westermani* infection to show bronchodilator reversibility. Parasitic diseases induce hypereosinophilia in peripheral blood; *P. westermani* infection is characterized by pulmonary aggregates of eosinophils and mast cells. A Th2-dominant immunological response to *P. westermani* infection was likely responsible for inducing the bronchodilator reversibility observed in this case.

Informed consent for publication of this report was obtained from the patient.

The authors state that they have no Conflict of Interest (COI).

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