Supplementary Material

Pneumoconiosis combined with connective tissue disease: A cross-sectional study

Wenjing Xu1,2, Ruimin Ma1, Jingwei Wang1, Di Sun1, Shiwen Yu1, Qiao Ye1
1Department of Occupational Medicine and Toxicology, Clinical Center for Interstitial Lung Diseases, Beijing Institute of Respiratory Medicine, Beijing Chao-Yang Hospital, Capital Medical University, Beijing 100020, China
2Department of Pulmonary and Critical Care Medicine, Wuhan Pulmonary Hospital, Wuhan 430030, China

Detail of the hospital

Beijing Chaoyang Hospital had a regional center for occupational medicine and worker's compensation. Patients with pneumoconiosis who have ever worked or lived in the city or been transferred from other regions will come to the hospital as outpatients or inpatients. To the northwest of the city is a mountain area that used to be many coal mines and gold mines. The years from 1950 to 2000 was the peak period of coal mining. By the end of 2020, all mines were closed. In addition, there were iron and steel enterprises in the west of the city, which were relocated, and productions were stopped in 2011. Most patients with coal workers' pneumoconiosis and silicosis were from these industries. The majority of the patients with asbestosis was from a district on the east of the city with the asbestos products factories ever opened from 1950s to 1970s located 20 kilometers away of the hospital. This study is based on an active recruitment of a long-term surveillance of the patients with pneumoconiosis for the worker’s compensation. All the reported pneumoconiosis patients with compensation have participated the surveillance plan. A clinical pathway was used for the diagnosis and evaluation of the disease and for the worker’s compensation.

Study design and population

Rheumatoid arthritis (RA) was diagnosed according to the 2010 American College of
Rheumatology/European League Against Rheumatism (ACR/EULAR) rheumatology classification criteria.\(^1\) Systemic sclerosis (SSc) was diagnosed according to the 2013 ACR/EULAR Systemic sclerosis classification criteria.\(^2\) Systemic lupus erythematosus (SLE) was diagnosed according to the 2012 Systemic Lupus International Collaborating Clinics Systemic lupus erythematosus classification criteria.\(^3\) Primary sjogren's syndrome (pSS) was diagnosed according to the 2002 American-European Consensus Group Sjogren's syndrome classification criteria.\(^4\) Idiopathic inflammatory myopathy (IIM) was diagnosed according to the 2017 EULAR/ACR idiopathic inflammatory myopathy classification criteria.\(^5\) ANCA-associated vasculitis (AAV) was diagnosed according to the 2012 Chapel Hill Consensus Conference ANCA-associated vasculitis classification criteria.\(^6\)

**Pulmonary function tests**

Pulmonary function tests were carried out by certified technicians according to the American Thoracic Society and European Respiratory Society.\(^7\) In this study, the pulmonary function prediction formula was based on the normal lung function prediction formula of Chinese adults established in 2016.\(^8\)

**Classification of pneumoconiosis by chest radiograph**

Each patient underwent chest radiograph which were independently assessed by two experienced clinicians according to the International Labor Organization classification,\(^9\) with interobserver correlation κ value 0.82. Pneumoconiosis was classified as stage I, II or III based on the density and distribution of small nodules and/or large opacities showed on chest radiograph. The methods on the classification of chest radiographs were applied in the online supplementary file.\(^10\) Pneumoconiosis was classified into three stages according to the International Labour Organization classification system.\(^1\) Briefly, each lung field was divided into three zones (upper, middle, lower) on the posterior chest radiographs. When the highest density of small opacities was \(\geq 1/0\), the distribution affected two or more zones and pleural plaques were
The apparent, the patients were diagnosed as Stage I. When the highest density of small opacities was $\geq 2/1$ and the distribution affected more than four zones, or the highest density of small opacities was $\geq 3/2$ and the distribution affected four or more zones, the patients were diagnosed as Stage II. When the highest density of small opacities was $\geq 3/2$ and the distribution affected four or more zones with aggregation of small or large opacities, or the diameter of the largest opacity was $\geq 20 \times 10$ mm, the patients were diagnosed as Stage III. The interobserver correlation was good, and the value was 0.82.

**High-resolution CT of the chest**

GE Brightspeed 64 - slice spiral CT was used for scanning. The patient was supine, with both hands raised over the head, exposing the chest as much as possible to make the scapula spread, and was scanned with continuous inhalation from the lung tip to the costophrenic recess and holding breath. Voltage 140 kV, current 300 mA, scanning layer thickness 5 mm, high resolution layer thickness 0.625 mm, spacing 10 mm, bone algorithm reconstruction, lung window: window width 1500 HU, window position 700 HU and Mediastinal window: window width 400 HU, window position 40 HU. Two physicians read the film independently. If there is any disagreement, consensus will be reached through discussion.

**Laboratory tests**

Autoantibody detection were detected using test kits from EUROIMMUN. Antinuclear antibodies were measured by an automatic indirect immunofluorescence device Sprinter XL (EUROIMMUN, Germany) and analyzed by automatic EUROP attern Microscope (EUROIMMUN, Germany). Antinuclear antibody (ANA) was detected by indirect immunofluorescence assay using ANA IgG detection kit, with an ANA titer of 1:80 or greater was considered positive. Anti-double stranded DNA (ds-DNA) antibody was detected by indirect immunofluorescence assay using an anti-dsDNA antibody IgG kit. Antibodies to extractable nuclear antigens (anti-ENA) was determined by EUROLINE using IgG kit of antinuclear antibody spectrum. Diluted sera were
incubated on ELISA plates at 25 °C for 2 h. Rheumatoid factor (RF) was detected by ELISA using RF IgM detection kit. Anti-citrullinated cyclic peptide (anti-CCP) antibodies was tested by ELISA using anti-CCP IgG detection kit. Anti-neutrophil cytoplasmic antibodies (ANCA): anti-myeloperoxidase antibody (MPO) was determined by ELISA using the anti-MPO IgG detection kit, and anti-protease 3 (PR3) antibody was determined by ELISA using the anti-PR 3 antibody IgG detection kit.

**Echocardiogram**

Philips transthoracic echocardiography (C7) was used to determine the results. Transthoracic echocardiography was performed for patients. The probability of PH development was assessed based on tricuspid regurgitation velocity (TRV) at rest as high (>3.4 m/s), intermediate (2.9–3.4 m/s) or low (≤2.8 m/s or not measurable), with the presence of additional echocardiographic variables that are suggestive of PH development also taken into consideration. TI method was used to estimate systolic pulmonary artery pressure (sPAP), sPAP≥35mmHg was diagnosed as pulmonary hypertension.

**References**


