



Case report

A case of pulmonary anthracofibrosis presented as multiple lung nodules

Eun Jin Kim^{a,*}, Keum Ju Choi^b^a Department of Internal Medicine, Daegu Catholic University Medical Center, Daegu, South Korea^b Department of Internal Medicine, Daegu Veterans Hospital, Daegu, South Korea

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ABSTRACT

A 73-year-old female living in the rural area presented with chronic cough. She had multiple rounded nodules less than 1 cm in size in both lungs, and bilateral mediastinal lymphadenopathy in chest images, which could be confused with metastatic cancer. Bronchoscopy did not show bronchial anthracofibrosis, and positron emission tomography (PET) scan showed F-18 fluorodeoxyglucose (¹⁸F FDG) uptake. Surgical biopsy histology confirmed that the nodule was anthracofibrosis and the lymph node was reactive hyperplasia. Pulmonary function was accompanied by obstructive ventilatory defects, and clinical symptoms and lung function were improved after the use of inhaled corticosteroid and bronchodilator.

1. Background

Anthracosis is a form of pneumoconiosis that presents in the bronchi, lung, and lymph nodes (LN) and is caused by coal dust or a smoky and polluted environment. Anthracofibrosis is often clinically confused with anthracosis. It is called anthracofibrosis when anthracosis is accompanied by bronchial mucosal thickening, which narrows the airways [1]. It appears mainly as ‘bronchial anthracofibrosis’ (BAF), which is characterized by anthracotic pigmentation and narrowing of the associated bronchi [2]. Hence, bronchial stenosis, endobronchial anthracotic pigmentation, and mediastinal lymphadenopathy accompany cases of BAF [1–5]. In few instances, a lung mass has also been reported along with anthracotic pigmentation of the bronchial mucosa [4]. BAF may also be accompanied by lung carcinoma [3,5].

The patient in this report presented with multiple pulmonary nodules less than 1 cm in size and large multiple mediastinal lymphadenopathy. The bronchial mucosa showed no evidence of anthracotic pigmentation; however, anthracofibrosis was demonstrated on lung biopsy. In this case, anthracofibrosis is not a clinical entity, but a combination of pathologically diagnosed anthracosis and fibrosis. This could be mistaken for metastasis and appeared to be positive on a positron emission tomography (PET) scan. We report a case of pulmonary anthracofibrosis, not BAF, and its clinical course in the form of multiple pulmonary nodules that showed no evidence of endobronchial pigmentation.

2. Case report

A 73-year-old female presented with chronic cough. She was referred for lung masses on a chest X-ray taken at another hospital with chronic cough. She denied sputum, dyspnea, body weight change, and fever. The patient reported only hypertension in the past. There was no smoking history, but she lived as a housewife in the countryside and had a personal history of wood and coal smoke for 30 years. Her vital signs included a blood pressure of 114/68 mmHg, a pulse rate of 77 beats per minute, a body temperature of 36.3 °C, and a respiratory rate of 20/minute.

Physical examination of her chest revealed normal breathing sounds during respiration, and there was no detected lymphadenopathy in the cervical or axillary regions. A chest X-ray (Fig. 1) revealed protruding masses in both hilar areas. In a computerized tomography (CT) scan of the chest (Fig. 2), multiple rounded nodules less than 1 cm in size were found in both lungs, evenly in both upper lobes, lower lobes, and right middle lobes. CT was also accompanied by bilateral mediastinal and hilar lymphadenopathy without calcification or bronchial stenosis.

In laboratory tests, complete blood count (CBC) showed normal leukocytes (9400/μL) and neutrophils (53.7%), but eosinophils were slightly elevated at 7% (normal range: 0–6%). Blood tests showed aspartate aminotransferase (AST) 23 U/L, alanine transaminase (ALT) 23 U/L, BUN 14.5 mg/dL, Creatinine 0.6 mg/dL, Na 140mmol/L, K 4.2 mmol/L. There were slightly increases in the levels of erythrocyte sedimentation rate (ESR) as 38 mm/hr (normal range: 0–20 mm/hr), C-

* Corresponding author. Department of Internal Medicine, Daegu Catholic University Medical Center, Nam-gu Du-ryu-gong-won-ro 17-gil 33, Daegu, 42472, South Korea. Tel.: 82 53 650 4274; fax: 82 53 650 4965.

E-mail address: ejkim77@cu.ac.kr (E.J. Kim).

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Fig. 1. Chest X-ray displays protruding masses in both hilar areas (white arrowheads) and small nodules (black arrowheads) in both lung fields.

reactive protein (CRP) as 8.3 mg/L (normal range <0.5 mg/L) and D-Dimer as 0.66 $\mu\text{g/ml}$ (normal range <0.4 $\mu\text{g/ml}$). Angiotensin converting enzyme (ACE) was normal as 40 U/L (normal range 20–70 U/L).

Both sputum routine cultures and acid-fast bacillus (AFB) smear cultures were negative. Interferon-gamma release assay to test for mycobacterium in the blood was also negative. Bronchoscopy (Fig. 3A) showed no endobronchial lesions and no pigment. AFB smear and culture in bronchial washing fluid was negative.

PET scan (Fig. 3B) was accompanied by F-18 fluorodeoxyglucose (^{18}F FDG) uptake with a maximum standardized uptake value (SUV) of 2.49 in multiple lung nodular lesions, and ^{18}F FDG uptake in bilateral hilar and mediastinal LN at a maximum SUV of 5.96. Taken together, these results suggested that metastasis or sarcoidosis was suspected.

Pulmonary function tests showed obstructive ventilatory defects with post-bronchodilator forced vital capacity (FVC) 2.03L (100% of predicted values), forced expiratory volume in 1 second (FEV1) 1.32L (96% of predicted values), FEV1/FVC ratio 65%, and forced expiratory flow between 25 and 75% of VC (FEF_{25–75%}) 0.72L (40% of predicted values). There was no bronchodilator reversibility as the FEV1 changed by 11% and 130ml.

As endobronchial ultrasound transbronchial LN aspiration and biopsy showed no evidence of metastasis in mediastinal LN, surgical wedge resection was performed. Hard masses were palpated in the right

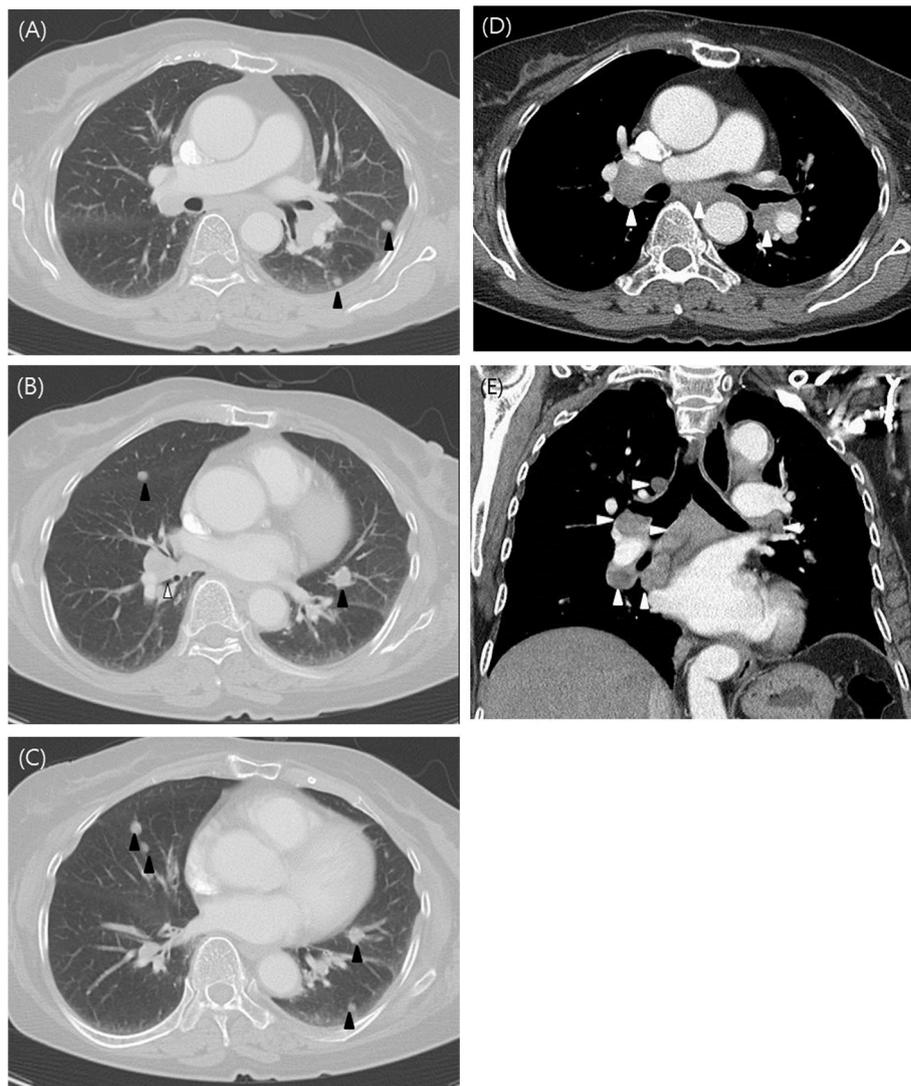


Fig. 2. Chest computed tomography scan (CT). (A)–(C) These images reveal several round and evenly distributed nodules (black arrowheads) that spread evenly over both lungs without airway obstruction. (D)–(E) It shows bilateral mediastinal and hilar lymphadenopathy without calcification (white arrowheads).

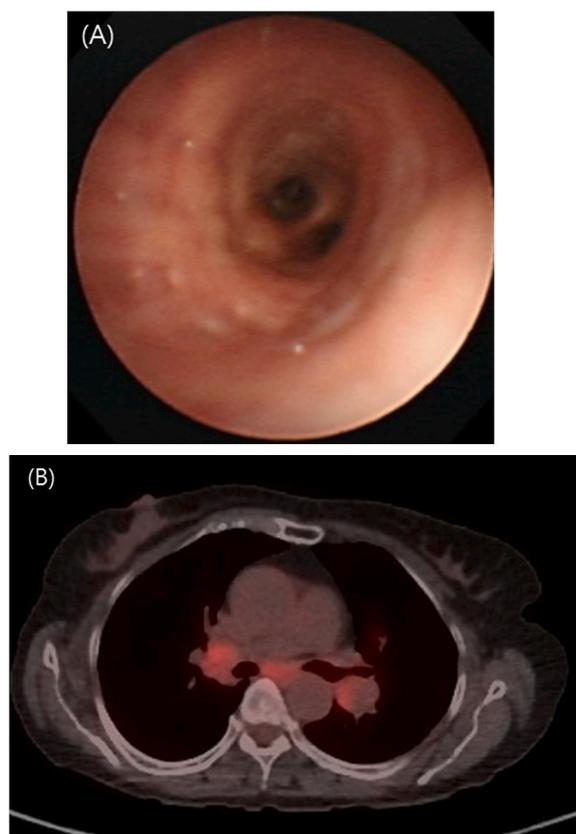


Fig. 3. (A) Bronchoscopy. There is no bronchial anthracotic pigmentation or narrowing. (B) 18F Fluorodeoxyglucose (18F FDB) Positron emission tomography (PET) scan shows that the maximum SUV was 5.96 in hilar and mediastinal lymph nodes and 2.49 in the pulmonary nodules.

middle lobe and wedge resection was performed. Mediastinal LN was also biopsied. Histopathologic examination (Fig. 4) revealed lung nodules were anthracofibrosis, and LN was reactive hyperplasia.

The patient was prescribed inhaled corticosteroid and long-acting beta-agonist bronchodilator (ICS/LABA) for obstructive ventilatory defects after surgery, and the cough symptoms improved.

The patient was followed up for chest CT and PFT after 6 months. There was no change in lung lesions on CT scan. Obstructive ventilatory defects were improved by FVC 2.28L (118% of predicted values), FEV1 1.75L (135% of predicted values), an FEV1/FVC ratio of 77% and FEF_{25–75%} 1.51L (87% of predicted values).

3. Discussion

Here we present a case in which multiple pulmonary nodules in an elderly woman living in a rural area were identified as anthracofibrosis by surgical lung biopsy. She was exposed to wood and coal smoke for 30 years. The pulmonary nodules could easily be confused with cancer metastasis and there was no BAF seen on the bronchoscope. Pulmonary function tests demonstrated obstructive ventilatory defects and improved lung function after using the inhaled ICS/LABA.

Anthracosis was common in coal workers in Europe in the 1960s and 80s [1], but recent reports show that it most frequently occurs in farmers (40%) [6] and rural dwellers (55–66%) [1]. A recent European report [7] showed the deposition of mica and silica crystals in calcified mediastinal LN in patients with anthracosis. According to one report [8], non-carbonaceous lung pollutants were silicon and aluminum, and another study [9] reported the deposition of silica, aluminum and iron. Taken together, the simultaneous exposure of carbon smoke from fuel combustion and inorganic compounds, including limestone and

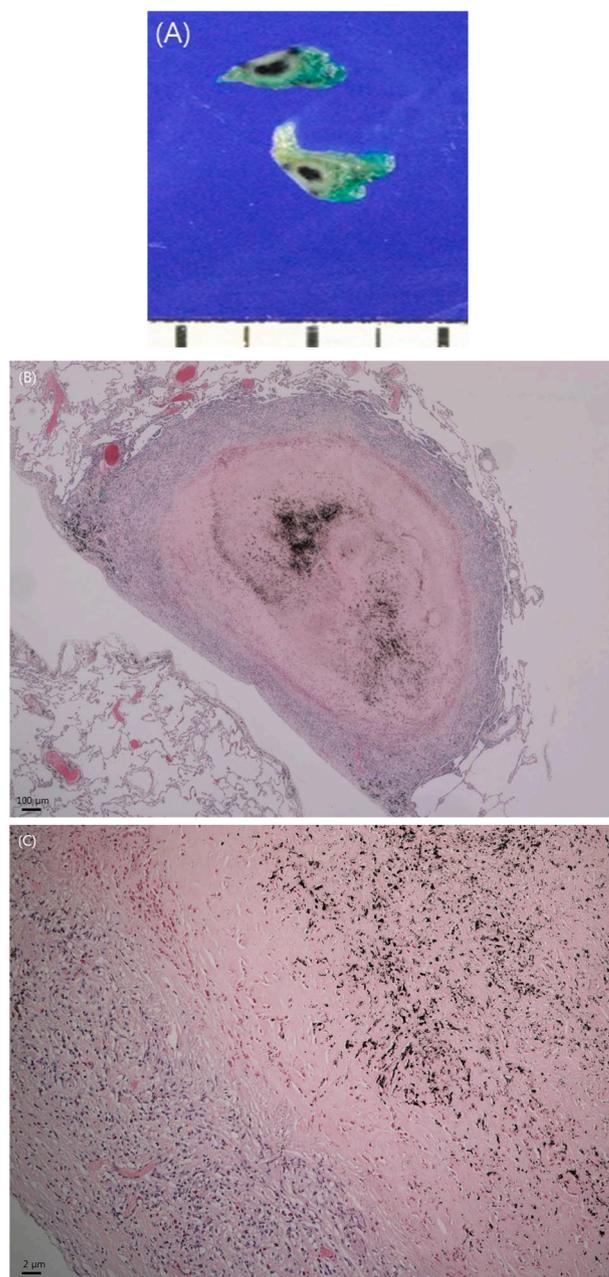


Fig. 4. (A) Gross appearance of pigmented pulmonary nodules in wedge resection of 0.5X0.4 cm. (B)–(C) Photomicrograph of pulmonary nodules showing anthracotic pigmentation and fibrosis in wedge biopsy (B, H&E 20x; C, H&E 100x).

alumina-silicates, seems to be the most likely cause of anthracosis [1,3,10].

Another representative cause of anthracosis has been reported as biomass smoke. This has been reported especially in Asia in areas such as Korea, India, Iran and Turkey [1,5]. Biomass smoke is produced by burning trees, leaves and animal dung for fuel, and appears to cause BAF mainly [5]. BAF can be identified by bronchial stenosis and anthracotic pigmentation during a bronchoscopy.

Due to the small size of the particulate inhaled (0.5–5 μ m) in coal workers' pneumoconiosis, small dust deposits in the respiratory bronchiole and lung parenchyma form small black macules that gradually progress to the nodules of the surrounding lung parenchyma. Further progression is known to cause progressive massive fibrosis (PMF) [11]. Large dust particles, on the other hand, are deposited in the upper

bronchial epithelium, mainly through inertial impact and sedimentation, and can cause industrial bronchitis.

In the form of pulmonary nodules, the cause of the present case is believed to be chronic inhalation of relatively small particulates of less than 5 μm , instead of deposition in the bronchi of large particles. However, unlike the coal worker's pneumoconiosis, where the nodules are mainly located in the upper lobe, this case is spread evenly in both lungs.

Many studies associated with anthracosis suggest that there is no association between the severity of pneumoconiosis and BAF [1,2,11]. According to a study by Kim et al. [11], this may be due to the difference in the developmental mechanism of each disease. Firstly, the particle size of the dust may be different. Dust that causes coal worker's pneumoconiosis, as mentioned earlier, is mainly caused by respiratory dust particles having a diameter of 0.5–5 μm ; larger diameter particles are known to cause occupational bronchitis. Therefore, the particles that cause BAF are thought to be larger than 5 μm . This supports that the cause of this case is small-sized particulate. Secondly, BAF was reported in only 3% of miners, stone breakers, and well diggers with dust over-exposure, suggesting that pneumoconiosis and BAF are less relevant [1]. Finally, differences in individual susceptibility to dust can affect the development of each disease. Coal worker's pneumoconiosis is mainly due to dust deposits in the respiratory bronchioles and lung parenchyma, resulting in lung damage. BAF causes bronchial stenosis and wall thickening with dust deposition in relatively large diameter bronchi, such as lobar or segmental bronchi. Within the same patient, the response to dust varies according to the anatomical part of the airway, and it may be caused by the difference in sensitivity to dust.

According to a report in BAF, mediastinal or hilar lymphadenopathy was reported in 94% and calcification in 57% in chest CT [12]. The mechanism for enlargements of multiple LN with calcification can be explained as follows. (1) Inhaled carbon-containing particles engulfed by macrophages enter the lymphatic system or promote the development of lymphatic tissue in the lungs. (2) Longer exposure periods increase the deposition of these carbon particles in lymphatic tissue. (3) Silica in biomass smoke can cause fibrosis and form nodular hyaline scars in the lung parenchyma or LN [5,13].

PET is a useful method to distinguish benign lesions from malignancy. However, its role in the diagnosis of malignancy in pneumoconiosis is uncertain. Strong uptake of ^{18}F FDG can occur in the fibrotic mass of PMF. This observation leads to confusion between PMF and lung cancer [10,14]. This case also showed ^{18}F FDG uptake in PET that could not be distinguished from malignancy.

In BAF, it is common for the pulmonary function to present mild obstructive ventilation patterns and class I and II Global initiative for chronic obstructive lung disease (GOLD) classifications [1,5]. The present study reported obstructive ventilation in pulmonary function, although there were no findings of obvious airway narrowing by bronchoscopy or CT. Especially, there was a decrease in FEF_{25–75%}, showing obstructive ventilatory obstruction of the small airways. In the present case, the lung deposition of small particles of dust does not occur in the large bronchus (lobar or subsegmental bronchi) but is believed to have

occurred in the small airways and lung parenchyma. This is thought to be the cause of the multiple pulmonary nodules and obstructive ventilatory defect of the small airways especially. Furthermore, symptoms showed improvement with the use of ICS/LABA inhalants.

4. Conclusion

This is a rare case of anthracofibrosis in the form of pulmonary nodules without BAF. It is believed to be chronic inhalation of small particulates less than 5 μm . Although there is no BAF, the presence of obstructive ventilatory defects and clinical improvement after the use of ICS/LABA inhalants suggests clinical significance in fine dusty environments these days.

Patient consent

Orally obtained.

Declaration of competing interest

No any commercial interest in this case.

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None.

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