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Case Report

Contribution of CT Scan in the Diagnosis of Pulmonary Silicosis in Exposed Workers: A Case Report and Review of the Literature

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Abstract

Silicosis is one of the most common occupational respiratory diseases in our environment. It occurs by inhalation of free crystalline silicon dioxide or silica, which causes a fibrotic response in the lung parenchyma. It manifests as diffuse interstitial disease. Clinical manifestations range from asymptomatic types to chronic respiratory failure. With the exclusion of other competing diagnoses, the diagnosis of silicosis is based on clinical history and radiological findings. Mycobacterial diseases, airway obstruction, and lung cancer are associated with silica dust exposure. As of now, there is no curative treatment. However, inclusive management strategies may help to improve the quality of life and slow deterioration. We report the case of a 56-year-old man, who presented acute exacerbation of a chronic cough and chest pain, who is a well-digger by profession, whose diagnosis of complicated chronic silicosis is made in front of the association of clinical and radiological findings. This paper illustrates the clinical, radiological, and functional aspects of silicosis.

Keywords: *Silicosis; Occupational Lung Diseases; CT Scan; Fibrosis; Lung*

Introduction

One of the most common occupational respiratory disorders in the world, silicosis is a widespread pulmonary interstitial disease defined by a fibrotic reaction in the lung parenchyma brought on by chronic inhalation of crystalline silica [1]. Visconti [2] gave the initial account in 1870. Although it happens globally, it is more prevalent in low- and middle-income countries, where the burden is frequently underreported due to inadequate surveillance [3]. Morocco's actual prevalence is unknown. It is one of the major occupational disorders, and there are differences in its presentation, clinical trajectory, and severity [3]. Due to the lack of a viable treatment, early detection and prevention are crucial for illness management. Since ancient times, silicosis has been recognized, and while prevention has improved. For both developed and developing countries, silicosis is a major cause of mortality and morbidity [4]. We report the case of a 56-year-old man, who presented acute exacerbation of a chronic cough and chest pain, who is a well-digger by profession, whose diagnosis of complicated chronic silicosis is made in front of the association of clinical and radiological findings. This paper illustrates the clinical, radiological, and functional aspects of silicosis.

Case Report

A 57 years old man, of rural origin, the patient had worked as well-digger for more than 20 years, without the use of any respiratory protective equipment, smoker, treated 6 years ago for pulmonary tuberculosis. Admitted to the hospital with a 2-week history of acute exacerbation of a chronic cough and chest pain. He had no haemoptysis, fever, or weight loss, pulse was 86/min., respiratory rate was 25/

min., tension arterial was 110/ 60 mmHg, O_2 saturation was 95%; in her respiratory system examination, tiny rales were present in both lungs, no palpable peripheral lymph nodes was found. Laboratory data, including blood tests and measurement of serum electrolytes, liver enzymes, bilirubin, and renal function, were normal. A tuberculosis skin test revealed negative results. Three sputum specimens were negative for acid-fast bacilli by staining and culture. CT scan of the chest (Figure 1 and 2) demonstrated a progressive massive fibrosis mass of the left upper lobe that measures 6 cm (Figure 1A, 2A and 2B), associated with diffuse micronodular opacities centrolobular and subpleural (Figure 2C), pseudoplaques (Figure 1C and 2B) ground-glass opacities, and eggshell calcifications of the hilar and mediastinal adenopathy (Figure 1B). During respiratory function test, severe restrictive type of impaired pulmonary function was detected (FEV1: 48%, FVC: 45%, FEV1/FVC: 90%). The diagnosis of complicated chronic silicosis was made on the basis of epidemiological, clinical and radiological findings and the exclusion of other diagnoses, in particular lung cancer. The latter remains the diagnosis to be feared given mass-like appearance. The patient was suspended from workplace and was followed up at the clinic.

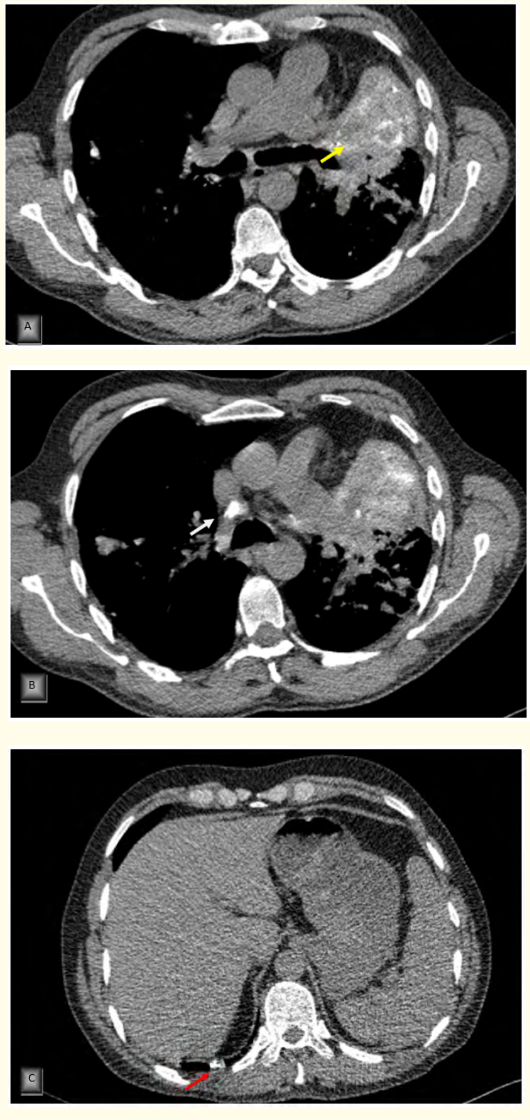

Figure 1: *Axial computed scans of the chest in the mediastinal window revealing a progressive massive fibrosis mass in the left upper lung lobe (Figure A, yellow arrow) grade 2 (6 cm), with Eggshell calcification of hilar lymph nodes (Figure B, white arrow) and pseudoplaques (Figure C, red arrow).*

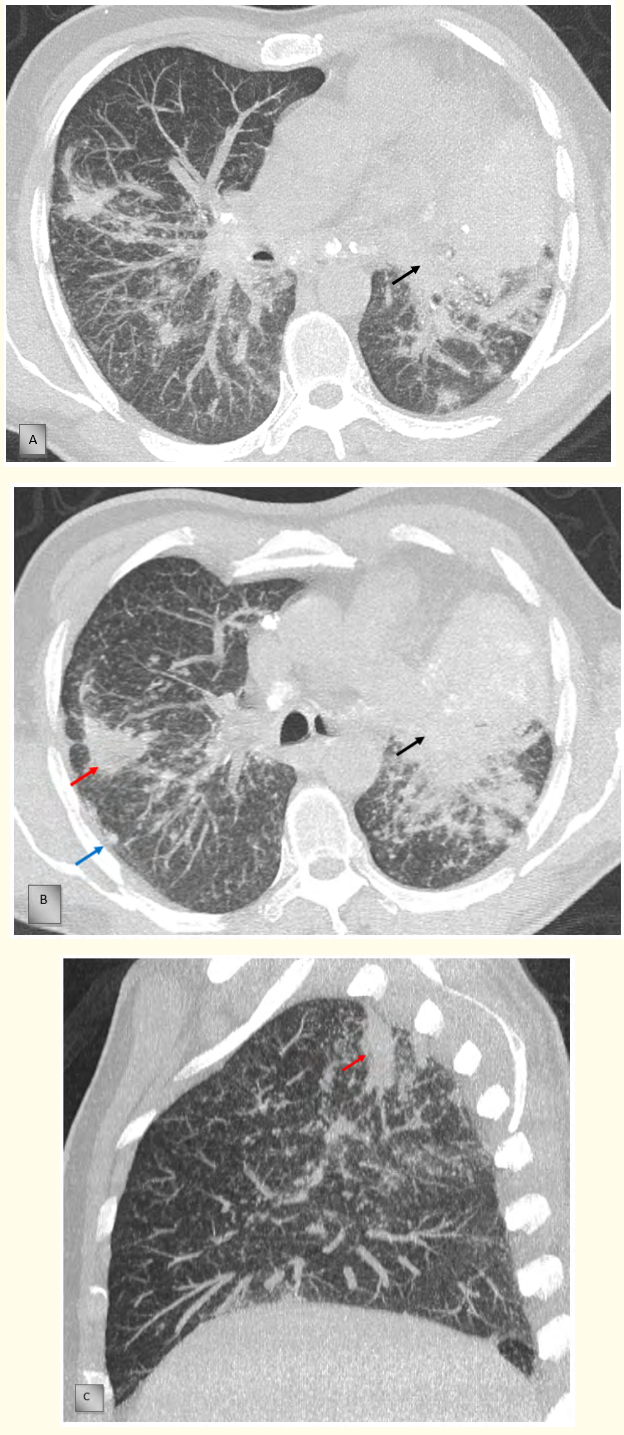

Figure 2: *Axial (Figure A and B) and sagittal (Figure B) thin-section CT scans of the chest in the lung parenchyma window, revealing a progressive massive fibrosis mass in the left upper lung lobe grade 2 (6 cm) (black arrow). Numerous rounded opacities are also observed in all lung zones. Bilateral nodular condensations surrounded by ground glass in some (red arrow) and confluent in others, giving a pseudo pleural plaque appearance (blue arrow).*

Discussion

One of the most common occupational respiratory disorders in the world, silicosis is a widespread pulmonary interstitial disease defined by a fibrotic reaction in the lung parenchyma brought on by persistent inhalation of crystalline silica [1]. Every society needs well-diggers since they are a necessary and crucial craftsman for the populace. The well-digger's craft has mostly not altered over the years, unlike other vocations that have seen significant alterations. He works with a variety of minerals on a regular basis, including silica, which is found in all parts of Africa and is therefore extremely silicogenic [5]. Workers may be exposed to silica dust in a variety of professions. Road maintenance, concrete production, coal mining, bricklaying, and rock excavation are among the high-risk professions. Workers who cut stone, extract oil, operate with steel, sandblast, and other materials are also at danger [6].

An individual's lifetime cumulative exposure to crystalline silica is substantially correlated with their likelihood of acquiring silicosis. While exposure is necessary, it is important to keep in mind that it does not determine everything. The accumulation and persistence of inhaled dust in the body is linked to a subject's susceptibility to the disease because of ineffective defense and clearance mechanisms that may be impacted by genetics or other factors, such as smoking, chronic obstructive pulmonary disease (COPD), or other respiratory diseases. Numerous opacities in imaging investigations, a history of tuberculosis, and high exposure levels have all been recognized as risk factors for disease development [1,5,7]. In our case, the risk factors found were the intensity and duration of exposure (more than 20 years) and individual susceptibility predominated by smoking and a history of pulmonary tuberculosis. Patients with silicosis who smoke have a higher chance of acquiring lung cancer than do patients with silicosis who do not smoke. In individuals with silicosis, Leung CC., *et al*. discovered a substantial link between smoking and tuberculosis. This study of 435 silicotics found that for non-smokers, ex-smokers, and current smokers, respectively, the annual incidence of tuberculosis was 1.841, 2.294, and 4.181 per 100.000 people [2].

The clinical, radiological, and functional data can be used to distinguish between various disease types. These are categorized as accelerated silicosis, acute silicosis, and chronic silicosis (simple, complex, and interstitial pulmonary fibrosis) [1]. The most common chronic forms are simple and complex, and they often manifest 10 to 15 years after exposure. From mild chronic silicosis, which is asymptomatic, to complex silicosis, which most usually manifests as dyspnea and cough, symptoms range. Dyspnea is the predominant sign of interstitial pulmonary fibrosis. Between the acute and chronic forms of silicosis, accelerated silicosis is a transitional condition that often manifests 5 to 10 years after exposure and advances more quickly and frequently to complex forms. Acute silicosis is typically brought on by prolonged exposure and presents with dyspnea, loss of weight, and deteriorating respiratory function [1].

Imaging plays a crucial role in the diagnosis and surveillance of this disease, commonly chest radiography (X-ray) and/or high-resolution computed tomography (HRCT) [8]. Radiologic findings depend on the form of silicosis [6]. In simple silicosis, chest X-ray shows variable features consisting mainly in well-defined opacities ranging from 1 to 10 mm in diameter, located in the upper lobe and posterior portion of the lung. CT-scan findings consist of multiple small nodules with hilar and mediastinal lymphadenopathy. Some nodules may be calcified. The simple form may progress to complicated silicosis (defined as presence of opacities > 1 cm) in a process of nodular conglomeration, parenchymal retraction and paracicatricial emphysema. In more severe cases, there is extensive structural breakdown with formation of fibrotic masses, respiratory failure, and chronic cor pulmonale. The presence of progressive massive fibrosis (PMF) could be used as an indicator of the disease severity and disability with silicosis. In acute silicosis, chest X-ray shows bilateral consolidation associated with ground-glass opacities. CT-scan findings consist of numerous centrilobular ground-glass opacities with consolidation. As for the interstitial pulmonary fibrosis, the radiological findings are very similar to those of idiopathic pulmonary fibrosis (IPF) [1,6,9-11].

The superiority of CT-scan over chest radiography in the evaluation of interstitial and parenchymal lung disease has been well-described [9]. Chest X-rays are ineffective at consistently identifying occupational lung disease. For instance, 43% of Queensland workers

in a cohort had chest X-rays that the ILO Classification System had deemed normal, despite the disease being evident on HRCT. Due to CT scans higher sensitivity to detect early disease and greater accuracy in characterizing patterns of disease, it is advised that HRCT also replace chest X-ray for the diagnosis of occupational lung disease [12-14]. Larici., *et al*. [15] concluded that HRCT is the imaging modality of choice. Although HRCT had a higher rate of early-stage detection, Ener., *et al.* [16] concluded that the cost, radiation exposure, accessibility, and lack of ability to evaluate pulmonary functions did not support the introduction of routine use in this setting. Although CT has a high sensitivity for the detection of pulmonary nodules and masses, PMF lesions are sometimes difficult to characterize. Therefore, a more invasive diagnostic approach such as a biopsy is required to distinguish malignant from benign lesions, in case of the mass does not exhibit the typical radiological characteristics of PMF [17]. The typical CT features of PMF are well documented; these include, irregular nodules/masses with calcification, commonly occurring in the upper and middle lung zones and areas surrounding the emphysematous lung tissue. PMF can increase slowly in size in general, and move towards the hilar region [17]. Diagnosis of silicosis is based on the concurrent appearance of the following criteria: (1) (a) Occupational history of crystalline silica exposure, (b) characteristic radiologic findings, and (c) other possible diseases ruled out.

The International Labor Office (ILO) has standardized the radiographic classification by providing guidelines for grading silicosis [18,19]. A variety of factors are taken into consideration when grading cases of silicosis, including the degree of pleural involvement as well as the size, shape, and profusion of opacities [20].

A variety of diseases have been identified as being associated with different forms of silicosis, including tuberculosis, neoplastic disease, autoimmune disease (rheumatoid arthritis, scleroderma, lupus, and progressive systemic sclerosis. In addition, renal disease without pulmonary changes has been associated with silica exposure and may manifest as nephritic syndrome or renal failure) [20].

Spirometry is a form of pulmonary function test. Spirometry is presently used to assess the risk of damage, identify lung disease, monitor workers exposed to particulate matter, and evaluate therapeutic interventions [21]. Although spirometry has been used as the first-choice technique to assess pulmonary alterations in workers exposed to particulate matter, it has limited sensitivity in detecting abnormalities before extensive damage appears [21].

Silicosis is a chronic progressive, irreversible, and incurable disease, that can cause morbidity, disability and death, based on its severity. According to Ng TP., *et al*. [5], silicosis severity, early age of employment, and silicotuberculosis are the main predictors of mortality in silicosis. To date, there is still no effective treatment for reversing lesions or slowing its advance, so efforts remain focused on the prevention. Regular medical examinations should be available to all workers who may be exposed to crystalline silica. Further efforts are needed for recognition and control of silica hazards, especially in developing countries [22].

There are currently a range of methods used for respiratory surveillance of workers exposed to respirable crystalline silica. These methods include health and exposure questionnaires, spirometry, chest x-rays and HRCT. However, these methods generally do not detect the disease until it has progressed significantly. Therefore, more and more research is being conducted on methods of early detection of silicosis, particularly biomarkers and exhaled breath condensate [13].

Conclusion

A diagnosis of silicosis has a profound effect on a patient's social and working life due to the fact that, unlike other diseases, it excludes any possibility of continuing to work in jobs with a risk of silica exposure regardless of functional involvement, so the diagnosis must be robust. Imaging plays a crucial role in diagnosis and surveillance of this disease.

Conflict of Interest

The authors do not declare any conflict of interest.

Author's Contributions

All authors contributed to this work. All authors have read and approved the final version of the manuscript.

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