Case Report

Denim Sandblasting and Silicosis: Two Case Reports

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Abstract

**Background:** Silicosis is one of the oldest recorded occupational lung diseases, known since the time of Hippocrates and the ancient Egypt. It is an untreatable illness characterised by irreversible and progressive fibrotic reaction in the lung tissue caused by inhaling silica dust crystals with aerodynamic diameters of 0.5-5.0 micron diameter. It is a significant cause of mortality in the developing or the underdeveloped countries of the world. Denim cloth sandblasting has become a job type causing the development of silicosis and although banned in Turkey in 2009, there are still cases being reported. We present here the case of two patients diagnosed with acute and accelerating silicosis.

**Cases:** Two male patients of 21 and 22 years of age, employed in the past in denim cloth sandblasting for approximately one year consulted our clinic with complaints of dyspnea and/or weight loss. In both cases imaging by posteroanterior x-ray radiography and computerised tomography (CT) revealed dispersed reticulonodular and nodular opacities in the upper and middle zones and peripheral regions of the lungs. After respiratory function tests, one of the patients was determined to have restrictive type of respiratory dysfunction and, given the symptoms, the radiological findings and the professional exposure to dust, was diagnosed with acute silicosis without the need for any invasive diagnostic intervention. The other patient developed obstructive type of respiratory disorder during follow up control. He was diagnosed with accelerated silicosis after wedge resection biopsy.

**Conclusion:** Worldwide popularity of the semi-bleached denim cloth has resulted in the switch of the required sandblasting technology from countries which have banned the technique to countries like Bangladesh and India with tolerance of the activity and cheaper labour costs. Although sandblasting of cloth was banned in Turkey in 2009, occasional cases of silicosis are still being met. As this type of occupation continues to threaten public health, there is need for effective intervention by the World Health Organisation (WHO) and the local health authorities in informing the public as well as controlling the work places.

INTRODUCTION

Silicosis is the lung disease developed by occupational inhalation of crystalline silicon dioxide (SiO₂) or silica. Exposure to inhalable silica particles with aerodynamic diameters within the 0.5 to 5.0 micron range results in irreversible and progressive fibrotic reaction in the lung tissue. Silicosis is preventable by impeding the inhalation of the silica particles [1]. Although the prevalence of exposure to silica has mainly been associated with tunnelling works, stone quarries and ore drilling sites, in the recent years workshops for production of sandblasted denim cloth, dental prostheses and ofteflon-coated utensils have also been marked as sites for development of occupational silicosis [2]. We have presented here the cases of two patients diagnosed with acute and accelerated silicosis, respectively, after employment for 6-12 months in denim cloth sandblasting workshops.

CASE PRESENTATION

Case 1

The 21-year old male patient consulted us with complaints of shortness of breath and weight loss. His medical history was without any events and he was a non-smoker. He had been employed for a year at a denim cloth sandblasting workshop. Respiratory system examination indicated bilateral upper zone ralls in the end of inspirium. Other systemic examination results were normal and laboratory test results were also within normal limits.

Pulmonary function test (PFT) results indicated a restrictive pattern of respiratory function loss with reduced lung capacity. The posteroanterior (PA) X-ray radiography showed diffuse micronodular infiltrations, with especially peripheral and upper zonal patchy consolidations. Thoracic CT revealed focal consolidations at upper right lobe apex and the posterior segment and at the left upper lobe apico posterior segment, and also diffuse and more defined multiple millimetric nodules at the lower lobes of both lungs (Figure 1). Results of triple testing of sputum samples by Ziehl-Neelsen staining technique for the Acid-Fast Bacillus (AFB) Smear and Culture were negative. On the grounds of occupational history, adequate exposure to silica...
dust and typical radiological data, the patient was diagnosed with acute silicosis due to denim cloth sandblasting. He was started on symptom oriented treatment. He was provided with the equipment for long term oxygen treatment of the respiratory insufficiency. The patient is currently under follow up control at the polyclinics.

Case 2

The 22-year old male patient had been referred to the pulmonology clinic after observation of reticulo nodular images on his posteroanterior x-ray radiograph required to supplement his job application (Figure 2). His medical history was uneventful. However, he had a history of three packs/years cigarette smoking, but had given up smoking for 3 years. He had worked for 6 months at a denim cloth sandblasting workshop three years previously. His physical chest examination did not yield a definite finding. Results of respiratory function test and laboratory tests were within normal limits. Imaging by CT showed in both lungs diffuse parenchymal millimetric nodules, and consolidation areas more evident in the right lung (Figure 2). Fiberoptic bronchoscopy and bronchoalveolar lavage (BAL) were performed to differentiate sarcoidosis, miliary tuberculosis and occupational lung disease. Cytologically, normal lymphocyte counts and benign pathological diagnosis were observed and the ARB culture results were negative. Serum angiotensin converting enzyme (ACE) level was 146.2 U/L, the normal range being 8-52 U/L. For diagnostic purposes video assisted thorascopic surgery (VATS) was used for wedge resection biopsy. Histopathological investigation of the obtained material showed a malgamating granulomas with centrally accumulated granular esosinophilic material consistent with granulomatous infection. The patient was diagnosed with accelerating silicosis due to denim cloth sandblasting on grounds of his occupational history, the duration of exposure to silica dust, the radiological findings and the results of the pathological investigations. The patient is under 6-monthly follow upon symptomatic, spirometric and radiological controls at the pulmonology polyclinic.

DISCUSSION

Sandblasting denim cloth is the process of abrasive wearing out of the cloth with fine sea sand under controlled pressure with dry air compressors. It is a cheaper and faster method as compared to the laser technology or the use of chemical agents. The technique was used increasingly between 1990 and 2009 in Turkey as one of the foremost exporters of denim cloth. This was generally carried out in poorly ventilated small workshops not properly controlled by the authorities until the banning of the method in March 2009 by the decision of the Ministry of Health [3,4]. The patients whose cases were presented here had been exposed to silica dust by employment in such workshops between 2003 and 2005.

Silicosis is characterised by the multiple small nodules
formed by deposition of silica crystals generally in the alveoli and terminal bronchioles. Massive progressive fibrosis can develop by the conglomeration of the nodules after long term exposure to dense dust of silica dust. Three types of silicosis have been described as: (1) The chronic (classical) type that develops after exposure to low concentrations of silica dust for over 15 years, when conglomerated nodules larger than 10 mm can be radiologically observed. (2) Accelerated silicosis resembles the chronic type but develops faster, in 5-10 years, and progresses despite cessation of exposure to silica dust. Case 2 discussed here was diagnosed as the accelerated type. (3) The acute type silicosis develops in shorter time than 5 years after exposure to dense silica dust and generally diffusely localised nodules smaller than 10 mm are observed in radiological investigation. Case 1 discussed in this report was of the acute and Case 2 was the accelerated silicosis.

The mechanism of silica toxicity has not been clarified. The observed effects have been attributed to the toxicity of the surfaces of the silica particles and also to the activation of the alveolar macrophages with the overproduction of reactive oxygen radicals. Comorbidity with tuberculosis (TB) and nocardiosis is highly prevalent in silicosis, which may be secondary to the toxic effect of silica on the pulmonary macrophages [3,5]. In both of the cases discussed in this report, TB was bacteriologically discarded.

When silicosis reaches the clinically symptomatic stage, the earliest symptom is dyspnea, initially observed upon exertion, but occurring at rest as the disease progresses. Algün et al., have shown that the most frequently observed symptom was dyspnea, with chest pain being the second most frequent symptom seen in 46% of 72 patients [3]. The patient diagnosed with acute silicosis (case 1) discussed in this report complained of dyspnea as the first symptom. If a comorbidity that causes dyspnea has not developed, the patient may be asymptomatic despite radiological evidence of silicosis. The patient diagnosed with accelerated silicosis in this report was symptom free but had been referred with coincidentally discovered radiological findings.

Yıldız et al., have shown that despite having spirometric values within normal limits, increased incidences of psychiatric symptoms of anxiety and depressive mood disorder adversely affect the life quality of silicosis patients [7]. Weight loss is another frequently observed symptom [6]. In time, hypoxemia at rest and after exertion, pulmonary hypertension, right cardiac failure and cor pulmonale can develop [7]. In the patient diagnosed with accelerated silicosis, discussed in the case 2 report, the hypoxemic respiratory function loss was treated with long term oxygen therapy.

In uncomplicated silicosis the earliest observed radiological finding is the presence of small round nodular opacities. Radiological detection of multiple nodules of 1-10 mm diameters is diagnosed as simple silicosis. Conglomeration of the nodules after long term contact resulting in fibrotic nodules larger than 10mm size with mass accumulation appearance is referred to as complicated silicosis. In CT investigations, pleural thickening neighbouring the conglomered lesions can be observed. However, pleural effuses are rarely observed [8,9]. In our patient diagnosed with accelerated silicosis, slight pleural fluid presence in the conglomated lesions was observed.

There is not a finding specific to silicosis in the evaluation of the PFT. Spirometry can be completely normal. In complicated silicosis with developed pathology, obstructive, restrictive or mixed pattern respiratory dysfunction can be seen. Since exposure to silica dust limits air flow, obstructive type of respiratory function loss is seen more frequently [10,11]. Case 1 and 2 discussed here displayed, respectively, the restrictive and the obstructive type of respiratory function loss.

For definitive diagnosis of silicosis a history of occupational exposure of adequate duration and typical radiological findings are adequate. When there is remaining doubt of TB despite negative results on sputum tests, or the need of differentiating progressive massive fibrosis from malignity, lung biopsy may be performed [12]. In the case 2 discussed in this report, a definite diagnosis of accelerated silicosis was enabled by the cytological investigation of the biopsy material obtained by VATS.

In treatment of silicosis, the priority is on immediate stopping of exposure to silica dust. If the patient is a smoker, cessation should be encouraged. Treatment is directly oriented to the complications of the disease. Lung or lung/heart transplant is recommended for young and terminal silicosis cases [13,14]. Both of the patients whose cases are discussed in this report had ceased getting exposed to silica dust. The patient diagnosed with hypoxemic type of respiratory dysfunction was started on long term oxygen support treatment. The other patient who presented with symptoms of obstructive type of respiratory function 7-years after the cessation of exposure to silica dust was started on bronchodilator treatment and informed on the possible complicating developments, and was put on intermittent polyclinic followup controls.

CONCLUSION

Worldwide fashion ableness of the abraded denim cloth of worn out appearance quiring large scale use of denim cloth sandblasting has resulted in shifting the technical application from countries banning the use of the technique to other nonprohibiting countries with cheap labour costs [15,16]. Despite the legal prevention of the use of the method in Turkey in March 2009, patients with symptoms do consult pulmonology clinics for diagnosis as the time span since the date of banning the method is consistent with the reported medical evidence for the development of the symptoms. Therefore, currently the health threat of the disease appears to persist. Given the prevalence of silicosis in countries not prohibiting the use of sandblasting, the local authorities and the WHO are expected to come up with effective measures to prevent the development of silicosis due to this type of occupation and also ensure that the vulnerable populations are informed about silicosis.

REFERENCES