




Case Report

Radiological Findings in the Case Exposed to Zirconium

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Abstract

Pneumoconiosis is a lung disease that develops as a result of a tissue reaction that occurs with the accumulation of inorganic particles. Pathoclinical features may vary depending on the type of inhaled particle. Today, fibrotic and nonfibrotic tissue reactions are well defined in some substances. For example, it is known that exposures such as silica, asbestos, beryllium, and talc are associated with fibrosis in the lung, while exposures such as iron, tin, and barium sulfate cause non-fibrogenic changes. However, the pathoclinic and radiological findings of some rare exposures such as zirconium are not widely known. In a 52-year-old dental technician with a 26-year history of zirconium exposure, more prominent parenchymal emphysematous and fibrotic changes were detected in the upper zones of the thorax high-resolution computed tomography. Since zirconium exposure was clearly defined, radiological findings of this case may be useful to current literature.

KEYWORDS: Pneumoconiosis, zirconium, dental technician, radiology

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INTRODUCTION

Due to its high resistance to heat and corrosion, zirconium has a wide industrial use, especially in metal casting, ceramics, and nuclear energy.¹ In the dental prosthesis industry, zirconium has been preferred because of its low sensitization potential and aesthetic advantages.² Despite the widespread use of zirconium compounds, their effects on human health are still not well-known. In this article, it is aimed to discuss the health effects of zirconium in light of the literature on the occasion of a case who applied to our clinic.

CASE PRESENTATION

A 52-year-old male patient was admitted to hospital with complaints of increased exertional dyspnea recently. He had no previous history of tuberculosis or pneumonia. He had a history of smoking for 30 years. He had worked as a dental technician for 28 years, and during the past 26 years, had designed and produced only zirconium substructure. He had been producing zirconium products on a CNC machine and finishing them with a micromotor for an average of

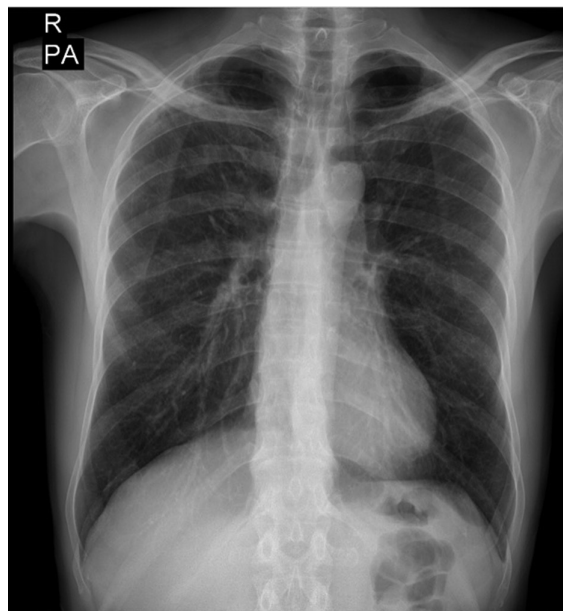


Figure 1. Chest x-ray of the case.

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Figure 2. Chest high-resolution computed tomography, axial images of parenchymal and mediastinal window.

3 hours a day. The dust vacuum system was insufficient and produced large amounts of dust. Additionally, 28 years prior, he had performed sandblasting for 30 min daily and polished chrome-cobalt partial dentures for 6 h a day over the course of 6 months.

In his pulmonary function test, forced expiratory volume in one second (FEV1) was 2800 mL (79% of predicted), forced vital capacity (FVC) was 3730 mL (85% of predicted), and FEV1/FVC ratio was 75%. The chest x ray of the case was reported as “quality 2 (scapula), s/p 1/1, ax, hi” according

to the International Labour Organization (ILO) International Classification of Radiographs of Pneumoconioses (Figure 1). The high-resolution computed tomography showed centrilobular, paraseptal emphysema (upper lobes predominant) and subpleural bullae in both lungs. In addition, bilateral fibrotic areas with traction bronchiectasis and structural distortion was seen in the apices. Also, ill-defined centrilobular micronodules were seen in the mid to lower zones. There were multiple mediastinal (levels 4R, 4L, 6, 7) and bilateral hilar (levels 10, 11) calcified ovoid-shaped lymph nodes (Figure 2). He did not accept invasive intervention due to the risk of morbidity (pneumothorax, hemorrhage, etc.). Since the pneumoconiosis in dental technicians is well defined in the literature, the patient was diagnosed with pneumoconiosis based on his occupational history, clinical, and radiological findings. He was informed about smoking cessation and vaccinations for influenza and pneumococcal. It was also recommended to reduce further occupational dust exposure. Written informed consent was obtained from the patient for publication of this case report and accompanying images.

MAIN POINTS

- There is no effective treatment for pneumoconiosis other than prevention.
- The human health effects of some rare workplace exposures, such as zirconium, are not widely known yet.
- Even if sufficient evidence is not yet available, precaution against their potential harm should be preferred.

DISCUSSION

In this case, it is important that the only chronic and regular respiratory exposure other than tobacco is zirconium dust. Unlike animal experiments, the biggest barrier to causality in human studies is variable exposures during the lifetime. The cytotoxic and weak mitogenic effects of zirconium compounds have been demonstrated in in vitro studies.³ Brown et al⁴ reported that as a result of acute oral and intraperitoneal administration of zirconium compounds, they accumulate in the lung tissue of rats and cause chronic interstitial pneumonia findings. There are many case reports about interstitial fibrosis associated with zirconium exposure have been described.⁵⁻⁸ However, the biggest problem in the diagnostic process is mixed respiratory exposures. In these studies, mineral analysis and demonstration of zirconium compounds in lung tissue contributed to the causality.⁷ Although biological explainability has been defined in animal studies, there is no epidemiological evidence yet to support these sporadic case reports in the literature. In the cohort studies, no significant difference was found between the control groups in the chest x-ray findings and functional evaluations of the sector workers exposed to zirconium compounds at the end of long-term follow-up.^{1,9} Dental technician profession is a well-defined occupation in the literature for pneumoconiosis, which develops as a result of tissue reaction that occurs with the accumulation of inhaled inorganic particles in the lung. The greatest risk in this sector is crystalline silica, which may be heavily exposed, especially during sandblasting and porcelain finishing operations.¹⁰ Metal dust and fumes such as chrome, cobalt, and nickel also cause pneumoconiosis.¹¹ Therefore, the silica and metal dust that our case was exposed to for 6 months, 28 years ago, are also important confounders. However, our case only reported exposure to zirconium finishing for the last 26 years. In addition, his smoking history is important in terms of centrilobular ground-glass nodules and emphysema identified in HRCT.¹²

The limitation of this case is that pathological examination could not be performed due to patient refusal. Although pathological examination is recommended in certain situations for definitive diagnosis in interstitial pneumonia,¹³ the possibility of complications should be evaluated. Considering the complication rates in interstitial lung disease, according to pooled analysis, pneumothorax and bleeding rates in transbronchial forceps biopsy were 6% and 10%, respectively. In transbronchial cryobiopsy, these rates were reported as 10% and 21%, respectively.¹⁴ Mortality, on the other hand, is most common in surgical lung biopsies, with 30-day and 90-day mortality rates of up to 2.4% and 3.9%, respectively.¹⁵ It is known that the risk of complications is higher in patients with pneumoconiosis. In a case series of pneumoconiosis in which CT-guided transthoracic lung biopsy was performed, complications were reported in almost half of the cases (46%).¹⁶

Pneumoconiosis can cause fibrotic and nonfibrotic tissue reactions depending on the properties of the inhaled particles. The prognosis is quite poor, especially in cases with progressive massive fibrosis as a result of exposure to silica and coal mine dust.^{17,18} Avoiding exposure slows the progression, however, there is no known effective treatment. Median

survival even after lung transplantation in pneumoconiosis patients is 2.8-3.7 years.¹⁹ Therefore, it is critical to define the risk and improve protection strategies for occupational exposure to prevent disease occurrence.

CONCLUSION

The health effects of zirconium compounds, which are widely used in many sectors, remain unknown. However, scientific certainty should not be a precursor to taking protective measures in working environments. The risk of error on the side of over-protection rather than under-protection should be taken into account.

Informed Consent: Written informed consent was obtained from the patient for publication of this case report and accompanying images.

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