Case report

Silicotuberculosis in Marble Handler

DOI: 10.5377/alerta.v8i1.19196

William Eduardo, Laínez Márquez

Internal Medicine Department, National Hospital of Santa Ana, Santa Ana, El Salvador.

Correspondence
williamlainez77@gmail.com

0009-0005-0335-3332

Silicotuberculosis en manipulador de mármol

Suggested citation:
Laínez Márquez WE. Silicotuberculosis in Marble Handler. Alerta. 2025;8(1):34-40. DOI: 110.5377/alerta.v8i1.19196

Editor:
Nadia Rodríguez.

Received:
May 4, 2024.

Accepted:
September 11, 2024.

Published:
January 22, 2025.

Author contribution:
WELM: study conception, manuscript design, literature search, data collection or software, data management and analysis, writing, revising, and editing.

Conflicts of interest:
No conflict of interest.

Abstract

Case presentation. A 58-year-old man with a medical history of hyperthyroidism and *cannabis* consumption of approximately 25 years. He presented a clinical picture of about two years of evolution with respiratory symptomatology, characterized by episodes of cough and dyspnea, in addition to symptoms of thyroid decompensation. The patient's symptoms were exacerbated in the two months prior to his initial consultation, accompanied by weight loss and unquantified febrile episodes. The patient has a 25-year work history of marble handling. **Treatment.** Interventions focused on making a comprehensive diagnosis. A bronchoscopy with bronchoalveolar lavage was performed which reported the presence of *Mycobacterium tuberculosis* and a transbronchial biopsy was taken which identified "pulmonary parenchyma with nodules consisting of hyalinized collagen bundles and surrounded by macrophages with brown pigments; in addition, he presented bronchial mucosa with chronic inflammation". Strictly supervised shortened treatment with antipyretics, an oral adrenergic beta-blocker, thionamides and counseling for addiction control and cessation of marble exposure was provided. **Outcome.** Respiratory and metabolic clinical improvement was evidenced. Follow-up with telemedicine was provided one month after medical discharge.

Keywords
Silicosis, Tuberculosis, Lung Diseases, *Mycobacterium tuberculosis*.

Resumen

Presentación del caso. Se presenta a un hombre de 58 años, con antecedentes médicos de hipertiroidismo y consumo de *cannabis* de aproximadamente 25 años. Presentó un cuadro clínico de alrededor de dos años de evolución con sintomatología respiratoria, caracterizada por episodios de tos y disnea, además de síntomas de descompensación tiroidea. Los síntomas del paciente se exacerbaron en los dos meses previos a su consulta inicial, se acompañaron de pérdida de peso y episodios febriles no cuantificados. El paciente posee 25 años de historia laboral de manipulación de mármol. **Intervención terapéutica.** Las intervenciones se centraron en realizar un diagnóstico integral. Se realizó una broncoscopía con lavado broncoalveolar que reportó la presencia de Mycobacterium tuberculosis y se tomó una biopsia transbronquial que identificó «parénquima pulmonar con nódulos constituidos por haces de colágeno hialinizados y rodeados por macrófagos con pigmentos pardos; además, presentó la mucosa bronquial con inflamación crónica». Se brindó tratamiento acortado estrictamente supervisado con antifímicos, un betabloqueador adrenérgico por vía oral, tionamidas y consejería para el control de adicciones y cese de la exposición al mármol. **Evolución clínica.** Se evidenció mejoría clínica respiratoria y metabólica. Se brindó seguimiento con telemedicina al mes del alta médica.

Palabras clave
Silicosis, Tuberculosis, Enfermedades Pulmonares, Mycobacterium tuberculosis.

Introduction

In 1870, the term silicosis was coined by Achille Visconti, a physician from Milan, who mentioned that the ancient Greeks and Romans were the first to recognize that dust particles inhalation could cause pulmonary problems. It was detected in miners as early as the 16th century[i]. It is an occupational lung disease caused by the inhalation of silica particles. This condition is characterized by lung inflammation and fibrosis. Prolonged exposure to silica increases the risk of developing tuberculosis, an infectious disease caused by *Mycobacterium tuberculosis*. The relationship between silicosis and tuberculosis (TB) is well known, as silicosis weakens the pulmonary immune system.[ii,iii]

In 1938, the U.S. Department of Labor launched a campaign entitled "Stop silicosis" to address the incidence of silicosis. The World Health Organization (WHO) and the International Labor Organization (ILO) commenced efforts to eliminate silicosis in 1995. However, the issue persists; public awareness and preventive programs aimed at eliminating silicosis worldwide set a goal to eradicate it by 2030[i]. On the other hand, co-infection with tuberculosis has shown an increase; when studying them, difficulties have arisen in the differential diagnosis between silicosis and tuberculosis due to the similarity of the clinical pictures (cough, dyspnea, and expectoration), which often makes the diagnosis of tuberculosis difficult.[iv]

Silicosis is prevalent in industries such as mining, construction, and glass and ceramics manufacturing. According to the WHO, millions of workers face the risk of silica exposure. According to the U.S. Department of Industrial Relations, the permissible limit for breathing crystalline silica is 50 micrograms per cubic meter for eight hours of work; however, most kitchen cabinet surface coating materials contain more than 90 % crystalline silica.[v,vi] This clinical case of a patient with silico-tuberculosis is presented due to the impact that the handling of silica-containing materials still has on public health.

Case presentation

A 58-year-old man who consulted with a 2-year history of dyspnea classified as grade 3 by the British modified Medical Research Council Dyspnea Scale (mMRC), which was relieved at rest and the cessation of activities, accompanied by coughing episodes of approximately one week's duration, alternating with episodes without cough, which triggered by exertion and got improved with rest, without secretion production, cyanosis or emesis; however, he did not attend a medical consultation at that time.

For the past year, the patient has noticed protrusion of both ocular globes, heat intolerance with nocturnal diaphoresis, and progressive and ponderal weight loss not quantified or associated with any apparent cause. Two months before the consultation, he presented palpitations and exacerbation of symptoms with progressive dyspnea during moderate exertion, for which he consulted at a private hospital in California, United States. Multiple studies were done, of which the patient had no record; he was diagnosed with hyperthyroidism and prescribed methimazole 10 mg, one tablet orally every eight hours, and propranolol 40 mg, one tablet orally every 12 hours.

Two months after the diagnosis of hyperthyroidism, the patient traveled to El Salvador, having interrupted the treatment for 11 days. At that time, his relatives noticed adynamia, dyspnea classified as grade 2 according to mMRC, altered state of consciousness with ideas of persecution, palpitations with mild intensity prechordalgia which did not radiate and lasted no more than five minutes, exacerbated by physical exertion and attenuated by rest. The family decided to consult a hospital center.

The patient worked for about 25 years handling marble and granite as a marble worker, creating structures and ornamental elements of buildings and other constructions without using protective equipment. There was no relevant surgical or allergic history. Daily consumption of *cannabis* in unspecified quantities for almost 25 years, which he stopped two years ago, and consumption of alcoholic beverages of about two to three cans of beer daily during the same period, which he stopped two years ago, were identified.

During the physical examination, the following vital signs were recorded: blood pressure of 120/70 mmHg, heart rate of 108 beats per minute with irregular rhythm; respiratory rate of 19 breaths per minute, oxygen saturation of 98 %, (FIO_2 21 %), body temperature of 37.2 degrees Celsius, weight of 57 kilograms, and height of 1.60 meters. The patient was alert but presented an alteration of orientation in all three spheres (time, place, and person), postural tremor, and bilateral protrusion of the eyeballs. The neck was examined using the Quervain, Crile, and Lahey maneuver, and nodules were identified in the right and left thyroid lobes, which were approximately 1 cm in diameter. In the examination of the thoracic region, a symmetrical thorax was observed, with a marked rib cage, without bulging or depressions, without the use of accessory muscles. During the Rouault maneuver, decreased pulmonary expansibility was found at the vertex and base levels. Vesicular murmur was heard in both lungs, accompanied by generalized fine cramps, predominant during the inspiration phase. Dermal thickening and increased pigmentation were present in the pretibial region of both lower extremities. No other anomalies were found.

Treatment

During the patient's hospital stay, a multidisciplinary approach involving specialists in internal medicine, pulmonology, psychology, nutrition, endocrinology, radi-

ology, and pathology was followed, with the support of third-level hospitals. Clinical laboratory studies were performed on admission and during hospital stay (Table 1).

A 12-lead electrocardiogram identified an atrial fibrillation rhythm with normal ventricular response. In addition, a chest X-ray was performed (Figure 1), and hospital admission was arranged under the diagnosis of thyrotoxicosis (Burch and Wartosky 40-point scale), suspected occupational silica pneumopathy, and suspected pulmonary tuberculosis.

Spirometry was performed and reported: "significant reduction in Forced Vital Capacity and restrictive pattern compatible with diffuse interstitial lung disease (ILD)" (Table 2). Echocardiography reported biauricular dilatation plus mild pulmonary hypertension of 29mmHg, with a left ventricular ejection fraction of 59 %, and *cor* atrial fibrillation arrhythmia.

Therapy was initiated for the underlying metabolic disorder. Thyrotoxicosis was controlled with hydrocortisone 300 mg intravenous (IV) loading, followed by 100 mg IV every eight hours; methimazole, one 10 mg tablet every eight hours, and propranolol, 40 mg orally every eight hours with monitoring for intensifying respiratory symptoms. Treatment with antifungal drugs was initiated following the result of bronchoalveolar wash. The report indicated: "*Mycobacterium tuberculosis* complex (MTB) detected, rifampicin resistance (RR) not detected, for Gene Xpert Ultra the MTB may be very low." The first phase included the administration of HRZE (Isoniazid 75 mg + Rifampicin 150 mg + Pyrazinamide 400 mg + Ethambutol 275 mg), four combination oral doses per day, except on Sundays, for two months as per the (Technical guidelines for the prevention and control of tuberculosis) of the Ministry of Health of El Salvador 2020. In the second phase, the physician prescribed antipyretics

Table 1. History of clinical laboratory studies

Parameters	Hospital admission	Day 4 hospital stay	Day 12 hospital stay
Leukocytes	5.71 x10^3	2.87 x10^3	7.11 x10^3
Neutrophils	2.05 x10^3	1.75 x10^3	3.63 x10^3
Lymphocytes	2.06 x10^3	0.93 x10^3	1.57 x10^3
Monocytes	1.54 x10^3	0.18 x10^3	1.77 x10^3
Eosinophils	0.04 x10^3	0.00 x10^3	0.12 x10^3
Hemoglobin	15 g/dL	15 g/dL	15.6 g/dL
Hematocrit	44.2 %	44.8 %	45.8 %
Platelets	291 x10^3	238 x10^3	296 x10^3
Creatinine	0.52 mg/dL	0.51 mg/dL	-
Chlorine	103 mEq/L	102 mEq/L	-
Magnesium	2,0 mg/dl	1,90 mg/dL	-
Sodium	134 mEq/L	135 mEq/L	-
Calcium	8.10 mg/dL	8.60 mg/dL	-
Glucose	104 mg/dL	-	-
Potassium	4.2 mEq/L	5.1 mEq/L	-
Total Bilirubin	0.40 mg/dL	-	-
TGO	29 UI/L	-	-
TGP	25 UI/L	-	-
Albumin	3.3 gr/dL	3.2 gr/dL	-
Rapid molecular test MTB/RIF of sputum	MTB not detected	-	-
Rapid HIV	test Not reactive	-	-
Lactate dehydrogenase	181 UI/L	-	-
Rheumatoid factor	10 UI/mL	-	-
Free T3	9.87 pg/mL	-	-
Free T4	2.83 ng/mL	-	-
TSH	0.002 mUI/mL	-	-

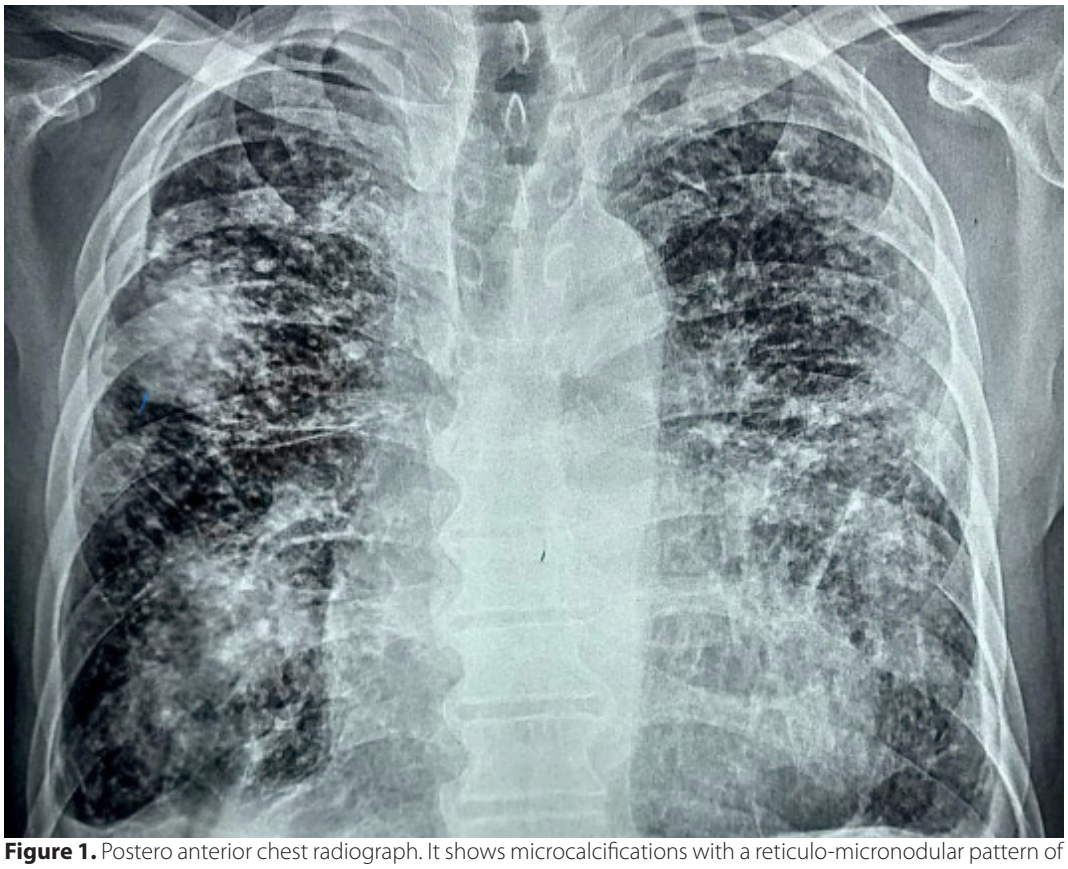

Figure 1. Postero anterior chest radiograph. It shows microcalcifications with a reticulo-micronodular pattern of diffuse distribution, with alveolar consolidation in the right upper lobe and in the lower lobe of the same side, with pleural thickening at bibasal level, probable finding due to bilateral pulmonary fibrosis with reduction of the pulmonary parenchyma, magnification of the cardiac silhouette with ventricular predominance, without growth of the pulmonary artery cone or right interlobar artery.

Table 2. Spirometry report

Parameters	Current	% pre	Current	% post
FCV	1.34 L	35 %	1.38 L	36 %
FEV1	1.28 L	42 %	1.2 L	39 %
FEV1/FCV	95.5 %	121 %	86.5 %	109 %
PEF	4.2 L/s	84 %	4.1 L/s	82 %
FEF 25-75	1.45 L/s	50 %	1.49 L/s	51 %

during clinical follow-up. The treatment was accompanied by counseling to avoid silica exposure and relapse to *cannabis* use, with follow-up in addiction services, pulmonology, endocrinology, internal medicine, and outpatient palliative medicine.

Outcome

The patient was discharged 12 days after admission with improved clinical condition. A follow-up was conducted via telemedicine 30 days after discharge. The patient´s clinical improvement and adherence to the treatment were confirmed through attendance to the outpatient controls at both primary and secondary levels. The patient underwent strictly supervised treatment for two months in the intensive phase and four months in the continuation phase. As for now, the patient has not relapsed to alcohol and has ceased exposure to silica.

Clinical diagnosis

The diagnosis of silico-tuberculosis was suspected upon appropriate anamnesis and physical examination. A pulmonary tomography was indicated, which showed findings compatible with pulmonary tuberculosis in the active phase (Figure 2). In addition, a fibro-bronchoscopy study with bronchial washes was performed, and a biopsy was taken, which reported a rapid MTB/

RIF molecular test: CMTB detected, RR not detected, and the histopathological result was suggestive of silicosis (Figure 3).

Discussion

Silicosis is a pneumoconiosis resulting from the inhalation of crystalline silica dust, present in materials such as quartz, sandstone, marble, and granite. It is one of the oldest occupational lung diseases and is included in the interstitial diseases classification. The physiopathology lies in the alveolar macrophages that phagocytize the silica particles, activating and perpetuating the inflammatory process through cytokines (TNF-a and IL-1), which recruit inflammatory cells in the alveolar wall. These cells release toxic oxygen derivatives and proteolytic enzymes that cause cell damage and destruction of the extracellular matrix, producing a fibrotic response in the lung parenchyma. The risk of developing silicosis depends on the sum of several factors, including the magnitude and time of exposure, given by the cumulative dose calculation, and individual sensitivity, determined by genetic and environmental factors.[ii,iii]

There is evidence that kitchen countertops are primarily made from artificial stone, marble, and quartz. Workers in this industry cut, sand, and polish these materials. In addition, environmental factors such as lack of ventilation and the absence of biosafety equipment contribute to exposure and detriment to workers' health.[vii,viii]

A limitation in the analysis is that El Salvador has no studies or reported cases that would allow for a deeper understanding of how this coinfection behaves in the national population or its relationship to environmental factors, unlike other countries such as India, the United States, and China, which have already studied databases of the most affected populations.

Exposure to these materials is classified into three main types: chronic silicosis (it develops after more than ten years of exposure to low levels of silica), accelerated silicosis (it occurs after five to ten years of exposure to high levels of silica); and acute silicosis (within a few months to five years of massive silica exposure).[ix]

Tuberculosis is an infectious disease caused by *Mycobacterium tuberculosis*, which mainly affects the lungs, though it can also affect other organs. It is often associated with specific populations, such as patients with immunodeficiencies or patients living in overcrowded conditions. The coexistence of silicosis and tuberculosis is known as silico-tuberculosis. There is a

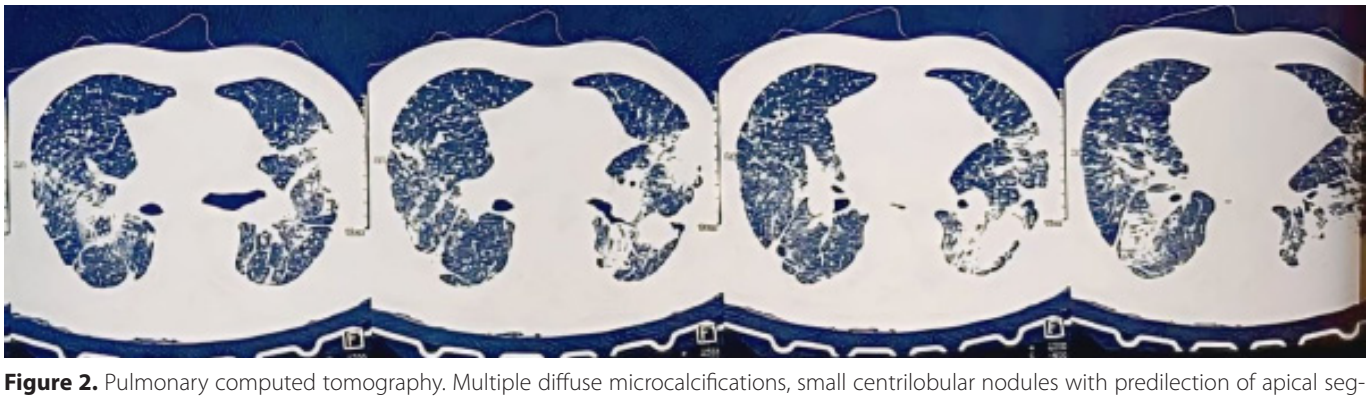

Figure 2. Pulmonary computed tomography. Multiple diffuse microcalcifications, small centrilobular nodules with predilection of apical segments, with the presence of alveolar pulmonary consolidations, one in the posterior segment of the right upper lobe, small diffuse calcified pulmonary granulomas, plus cardiomegaly grade III, these findings are compatible with pulmonary tuberculosis in the active phase.

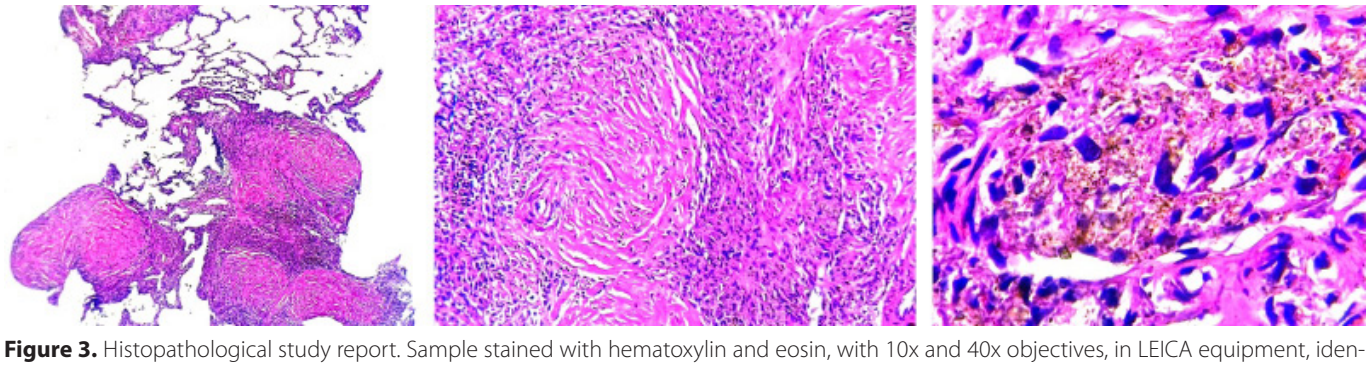

Figure 3. Histopathological study report. Sample stained with hematoxylin and eosin, with 10x and 40x objectives, in LEICA equipment, identifying pulmonary parenchyma with nodules consisting of hyalinized collagen bundles surrounded by macrophages with brown pigments, bronchial mucosa with chronic inflammation, suggestive of silicosis.

high correlation between the two diseases to the extent that it is part of the screening of all patients diagnosed with silicosis. It has been shown that silica particles facilitate intracellular replication and release of MTB from macrophages.[ii,x-xii]

Symptoms of silicosis include persistent cough, dyspnea, fatigue, chest pain, and weight loss. In advanced cases, it can lead to respiratory failure. There is a medical lecturer who presented these findings.[iii,xiii,xiv]

The diagnosis of silicosis is based on the occupational history of the patient, who has 25 years of silica exposure manufacturing marble and granite structures. The exposure ended two years ago, and symptoms of chronic lung parenchymal damage were already evident. In addition, distinctive radiological findings were identified on chest radiography and chest computed tomography, where diffuse microcalcifications, reticulate-nodular pattern, and alveolar consolidations were observed. The diagnosis of pulmonary tuberculosis is made by sputum testing for *Mycobacterium tuberculosis*, chest x-rays with suggestive findings, and skin or blood tests (such as the Mantoux test and interferon-gamma-release assay). Other diagnostic studies are indicated only for atypical cases or poorly documented exposure history, using fibrobronchoscopy, bronchoalveolar wash, or lung tissue biopsy.[ii,vi,xi,xii,xv]

The management of silico-tuberculosis consists of eradicating the occupational activities that caused the pathology, such as exposure to marble, granite, and silica without consideration of human and environmental safety to avoid exacerbations. Treatment for tuberculosis should be provided immediately with antiphimics to avoid the transmissibility of the disease, achieve a cure for the sick person, and avoid probable chronic damage to the pulmonary parenchyma.

Prevention and control measures involve reducing exposure to silica dust through personal protective equipment, adequate ventilation, and environmental monitoring. There is no specific treatment for silicosis. Management includes supportive measures such as bronchodilators, oxygen therapy, and, in severe cases, lung transplantation. However, pirfenidone and nintedanib, approved by the US Food and Drug Administration (FDA) for idiopathic pulmonary fibrosis, have been used in patients with silicosis. The use of tetrandrine, a bis-benzylisoquinoline alkaloid molecule, which inhibits inflammation and fibrosis in the airways, and improves lung function, has also been documented in China.[xvi,xvii]

Lung transplantation remains the primary treatment for chronic silicosis; however, it is expensive, complex, and high-risk, with a short median survival for patients of six to seven years.

The literature supports and recommends that all patients with silicosis and a positive TB screening should be treated with an antituberculous regimen for six months, in cases of drug-sensitive MTB.[ii,xi-xiii,xv,xviii]

Ethical aspects

The preparation of this case is based on the Helsinki principles, which guarantee the confidentiality of the patient, who authorized the publication of the clinical case and images through informed consent.

Aknowledgments

To the Department of Pathology and Fibrobronchoscopy of the Dr. José Antonio Saldaña National Hospital, for their support in taking and processing the samples submitted.

Funding

There were not external funds for this work.

References

i. Sharma S, Nayak S, R B, Singh K. Silico-tuberculosis: An updated review. Indian J. Tuberc. 2024;71(4):471-475. DOI: 10.1016/j.ijtb.2024.01.005

ii. D'Sa L, Pezzuto F, Lunardi F, Scalvenzi F, Tinè M, Comacchio G, *et al.* A Complex Case of Pulmonary Silico-Tuberculosis and Review of Literature. Diagnostics. 2023;13(17):2728. DOI: 10.3390/diagnostics13172728

iii. Maher TM. Interstitial Lung Disease: A Review. JAMA. 2024;331(19):1655. DOI: 10.1001/jama.2024.3669

iv. Cerpa B. Silicosis complicada con Tuberculosis. Interciencia Médica. 2023;13(2):74-78. DOI: 10.56838/icmed.v13i2.145

v. Heinzerling A, Cummings KJ, Flattery J, Weinberg JL, Materna B, Harrison R. Radiographic Screening Reveals High Burden of Silicosis among Workers at an Engineered Stone Countertop Fabrication Facility in California. Am. J. Respir. Crit. Care Med. 2021;203(6):764-766. DOI: 10.1164/rccm.202008-3297LE

vi. Rose C, Heinzerling A, Patel K, Sack C, Wolff J, Zell-Baran L, *et al.* Severe Silicosis in Engineered Stone Fabrication Workers — California, Colorado, Texas, and Washington, 2017-2019. MMWR Morb. Mortal. Wkly.

Rep. 2019;68(38):813-818. DOI: 10.15585/mmwr.mm6838a1

vii. Requena-Mullor M, Alarcón-Rodríguez R, Parrón-Carreño T, Martínez-López JJ, Lozano-Paniagua D, Hernández AF. Association between Crystalline Silica Dust Exposure and Silicosis Development in Artificial Stone Workers. Int. J. Environ. Res. Public. Health. 2021;18(11):5625. DOI: 10.3390/ijerph18115625

viii. Hoy RF, Chambers DC. Silica-related diseases in the modern world. Allergy. 2020;75(11):2805-2817. DOI: 10.1111/all.14202

ix. Adegunsoye A, Ryerson CJ. Diagnostic Classification of Interstitial Lung Disease in Clinical Practice. Clin. Chest Med. 2021;42(2):251-261. DOI: 10.1016/j.ccm.2021.03.002

x. Abreu L. La silicosis como enfermedad profesional: El caso de la empresa cosentino. Tesis de grado. España: Universidad de las Palmas de Gran Canraria; 2019.48p.

xi. Lanzafame M, Vento S. Mini-review: Silico-tuberculosis. J. Clin. Tuberc. Mycobact. Dis. 2021;23:100218. DOI: 10.1016/j.jctube.2021.100218

xii. Tello F, Caballero JA. Silicosis y tuberculosis. Arch. Bronconeumol. 1971;8(3):233-242. Available at: https://www.archbronconeumol.org/en-silicosis-tuberculosis-articulo-X0300289671309809

xiii. Rubado P, Mirabal Y, Taboada M, Montoya R, Martínez A, Gullo R, *et al.* Silicosis crónica complicada, hallazgo en un paciente asintomático. Rev. Am. Med. Respir. 2022;22(3):225-229. DOI: 10.56538/ramr.FRJT7819

xiv. Wong AW, Danoff SK. Providing Patient-Centered Care in Interstitial Lung Disease. Clin. Chest Med. 2021;42(2):337-346. DOI: 10.1016/j.ccm.2021.03.003

xv. Lineamientos técnicos para la prevención y control de la tuberculosis, Ministerio de salud. San Salvador, El Salvador, 2020. Available at: https://asp.salud.gob.sv/ regulacion/pdf/lineamientos/lineamientost ecnicosparalaprevencionycontroldelatuberc ulosis-Acuerdo1513.pdf

xvi. Li T, Yang X, Xu H, Liu H. Identificación temprana, diagnóstico preciso y tratamiento de la silicosis. Kompass Neumol. 2023;5(1):12-15. DOI: 10.1159/000528746

xvii. Delgado D. La tetrandrina: como tratamiento emergente de la silicosis. Rev. Colomb. Salud Ocupacional. 2022;11(2). DOI: 10.18041/2322-634X/rcso.2.2021.7901

xviii. National Heart, Lung and Blood Institute. What Are Interstitial Lung Diseases? Interstitial Lung Dis. 2022. Consulted on May 19, 2024. Available at: https://www.nhlbi.nih.gov/health/interstitial-lung-disease