Annals of Medicine and Surgery 78 (2022) 103794

Contents lists available at ScienceDirect

Annals of Medicine and Surgery

journal homepage: www.elsevier.com/locate/amsu

Case Report

Deadly dust: Silicotuberculosis as a downplayed and overlooked fatal disease in Indonesia

Yovita Citra Eka Dewi Djatioetomo [a], Isnin Anang Marhana [a,*]

[a] Department of Pulmonology and Respiratory Medicine, Faculty of Medicine, Universitas Airlangga – Dr. Soetomo General Academic Hospital, Surabaya, Indonesia

ARTICLE INFO

Keywords:
Occupational lung disease
Silicotuberculosis
Silicosis
Tuberculosis

ABSTRACT

Background: Silicosis is one of the most common diseases among all occupational diseases. The main clinical focus on the silicosis complication will be tuberculosis.

Case presentation: A 28-year-old male presented with complaints of chronic dry cough, weight loss, decreased appetite, and night sweats. The patient worked in the synthetic leather factory for 7 years and rarely used proper protective equipment. Chest X-ray showed bilateral fibroinfiltrate as a sign of a specific process in the lungs. Thoracic HRCT suggested an infected cystic type of bronchiectasis. Bronchoalveolar lavage from bronchoscopy was performed. The result of the silica spectrophotometric test and GenXpert BAL was both positive for silicosis and tuberculosis, consecutively. The patient has been diagnosed with an occupational lung disease accompanied by tuberculosis complications, namely silicotuberculosis. The patient received tuberculosis therapy and was advised to an early retirement due to disability.

Discussion: The duration and level of intensity of exposure, as well as the severity of silicosis, are factors of tuberculosis. The silicosis diagnosis can be made from occupational history or silica exposure, as well as appropriate radiological and histopathological findings.

Conclusion: Silicotuberculosis is a disease due to silica exposure, and is often found in TB endemic countries.

1. Introduction

Pneumoconiosis is the most frequently found disease among all occupational diseases [1]. Silicosis is one of the most common pneumoconioses [2]. Silicosis is a pulmonary fibrosis disease caused by inhalation, retention, and pulmonary reaction to silica crystals that contain silicon dioxide (SiO2) [3]. Tuberculosis (TB) is a complication of silicosis that has become a focus of clinical attention over the last few centuries. The risk of developing tuberculosis is reported to be 2.8 to 39 times higher in patients with silicosis compared with healthy individuals [4]. Based on the description above, this study reported a case of Indonesian adults with silicotuberculosis. We report based on SCARE guideline 2020 [5].

2. Case presentation

A 28-year-old male complained of having dry cough for 3 months accompanied by decreased appetite, lost weight of about 3 kg in the last three months, and night sweats. The complaints were progressively getting worse each day. The patient's condition was debilitated with a respiratory rate of 24 × /min and SaO2 of 99% with oxygen support (nasal cannula) of 3 L/min. There was no history of other diseases, and the patient did not smoke. The patient worked as a manual laborer in a synthetic leather factory for the last 7 years.

From the chest X-ray examination, reticulogranular patterns were found in the right and left paracardial areas, accompanied by fibroinfiltrates on both sides of the lung (Fig. 1). The results of thoracic HRCT showed cystic type dilatation and thickening of the superior, middle, inferior right lung's bronchial branches, and inferior bronchial branches of the left lung and fibrosis in the anterobasal segment of the right inferior lobe (Fig. 2).

The bronchoscopy performed on the patient on the 10th day of treatment indicated normal results, and samples were taken from bronchoalveolar lavage (BAL) for silica and GenXpert spectrophotometer tests. The results of the silica spectrophotometric test obtained 27.25 ppm SiO_2. Meanwhile, the Xpert BAL gene detected the presence of *Mycobacterium tuberculosis* which was sensitive to rifampicin. This patient was treated according to tuberculosis category 1 guidelines,

* Corresponding author. Department of Pulmonology and Respiratory Medicine, Faculty of Medicine, Universitas Airlangga – Dr. Soetomo General Academic Hospital, Jl. Mayjend No. 6-8, Airlangga, Gubeng, Surabaya, East Java 60286, Indonesia.
E-mail address: isnin.anang@fk.unair.ac.id (I.A. Marhana).

https://doi.org/10.1016/j.amsu.2022.103794
Received 10 March 2022; Received in revised form 9 May 2022; Accepted 11 May 2022
Available online 17 May 2022

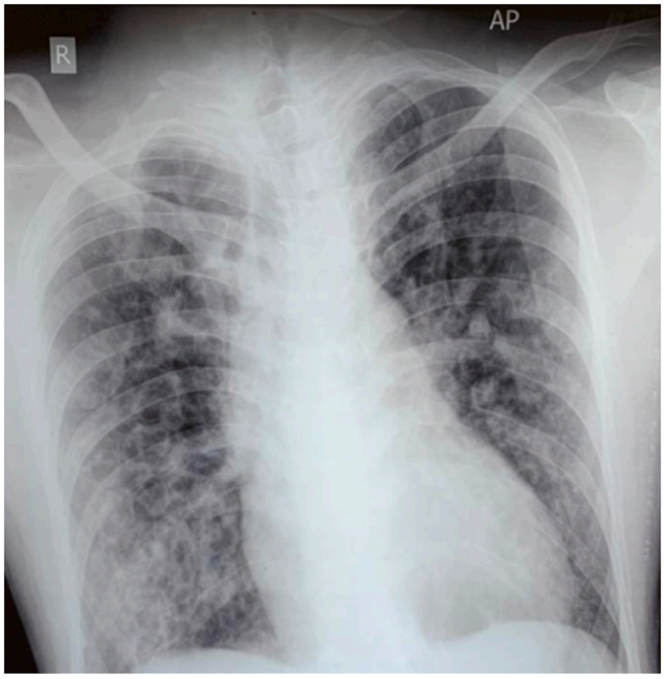

Fig. 1. Chest X-ray showed reticulogranular patterns found in the right and left paracardial areas, accompanied by fibroinfiltrates on both sides of the lung.

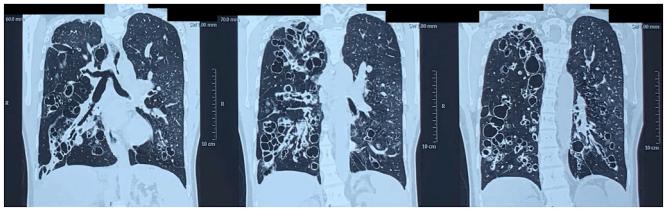

Fig. 2. Thoracic HRCT showed cystic type dilatation and thickening of the superior, middle, inferior of the right lung's bronchial branches, and inferior bronchial branches of the left lung, and fibrosis in the anterobasal segment of the right inferior lobe.

namely with rifampicin of 600 mg/day, isoniazid of 300 mg/day, pyrazinamide of 1500 mg/day, and ethambutol of 1000 mg/day. In addition to the treatment of tuberculosis, symptomatic treatment was given to address other symptoms.

3. Discussion

Silica particles in the lungs will cause interference with tuberculosis immune control. Silicosis causes an increase in TB infection through a type 2 immune reaction. Silica will increase the response of Th2 cells and M2 macrophages, but the type 1 immune reaction which is essential in controlling TB infection will decrease. Silica induces lung damage, promotes the release of extracellular DNA, and activates the stimulator of IFN genes (STING). STING will increase the DNA potentiation of TB bacteria and increase interferon. Interferon will increase type 2 immune reactions and reduces type 1 immune reactions so that TB infection will worsen [6]. In addition, excessive surfactant protein A is associated with susceptibility to TB. The inhibition of reactive nitrogen species production by activated macrophages allows TB bacteria to enter alveolar macrophages without triggering cytotoxicity. Therefore, mycobacterium tuberculosis can survive and be encapsulated in silicosis nodules [4].

The diagnosis of silicosis can be observed from the history, physical examination, and investigations. In clinical silicosis, the patient will experience progressive severe shortness of breath, hypoxemia, cor pulmonale, respiratory failure, and even death. Adequate long duration of silica exposure might not be found in patients exposed to high doses of silica. The diagnosis of silicosis is constructed based on an occupational history of exposure to silica dust with appropriate radiological and histopathological findings. LAB specimens will be examined by spectrophotometric method to determine the silica content in units of SiO2 ppm [7]. Analysis of LAB fluid can reveal lymphocytosis and neutrophils in acute silicosis. In a study of patients with acute silicosis, 70% of BAL macrophages contained silica particles [8]. TB investigations should be performed on patients with suspected silicotuberculosis. *Mycobacterium tuberculosis* is often not discovered on sputum examination because silica fibrosis inhibits the production of tubercle bacilli in sputum. Cultured acid-fast bacilli are often categorized as non-tuberculous mycobacteria (NTM) [9].

Plain chest radiographs, with the International Labor Organization (ILO) classification, have traditionally been used as the standard in screening and diagnosing silicosis in workers [10]. The classic picture of silicosis on chest radiographs is irregular opacity with a small, symmetrical pattern. The diameter of the opacity is usually more than 1 cm and is most commonly found in the upper and mid-lung areas. The appearance of asymmetric nodules, consolidation, cavitation, and rapid disease change suggest the presence of TB in a patient with silicosis. A computed tomography scan (CT-scan) of the chest is superior to plain chest radiographs for detecting early-phase silicosis and is better at detecting nodular addition. CT scan often shows calcification surrounded by emphysema. Peripheral hilar calcification with an eggshell-like shape presents in 5% of silicosis, and it becomes a pathognomonic sign of this disease [11].

There is still no proven, effective treatment for silicosis. Treatment is aimed at the complications of the disease. Should the disease has caused symptoms, symptomatic therapy is conducted such as giving oxygen, bronchodilators, and antibiotics should infection appears [12,13]. The most important management is the prevention of silicosis. Prevention is carried out in workplaces that have a risk of silicosis. Identification of risk factors for this disease benefits not only the academic research community but also workers or employees and policymakers. Several strategies could be implemented, such as controlling or reducing exposure to silica dust, ensuring continuity of TB treatment, managing the situation by medical personnel, providing occupational health training and education, improving the quality of life of workers, inducing intensive medical surveillance and TB screening in routine health checks, and regulating policy to reduce inhalation of dust by workers or employees [4]. Based on this evidence, the US Occupational Safety and Health Administration (OSHA) lowers the occupational exposure limit for crystalline silica from 0.1 to 0.05 mg/m^3 [14]. Good ventilation in the workplace should be provided so that clean air could enter and dust would not accumulate in the workplace. Therefore, it is important to increase awareness of the occurrence of silicosis in high-risk workers [15].

4. Conclusion

Silicotuberculosis is a disease that is often encountered in patients with a history of silica exposure in TB endemic areas. The diagnosis of both diseases is often difficult to establish because of overlapping clinical and radiological features. Bronchoalveolar lavage examination plays an important role in the diagnosis of silicotuberculosis with the discovery of silica particles and TB germs. The management of silicosis is still limited to symptomatic drug administration and infection control. The anti-TB medication is given to silicotuberculosis patients according to the standard regimen. Therefore, it is important to increase awareness of the occurrence of silicosis in high-risk workers.

Provenance and peer review

Not commissioned, externally peer-reviewed.

Sources of funding

None.

Ethical approval

Not applicable.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Author contribution

All authors contributed toward data analysis, drafting and revising the paper, gave final approval of the version to be published and agree to be accountable for all aspects of the work.

Registration of research studies

1. Name of the registry: -.
2. Unique Identifying number or registration ID: -.
3. Hyperlink to your specific registration (must be publicly accessible and will be checked): -.

Guarantor

Isnin Anang Marhana.

Declaration of competing interest

Yovita Citra Eka Dewi Djatioetomo and Isnin Anang Marhana declare that they no conflict of interest.

Acknowledgment

We would like to thank Fis Citra Ariyanto as our manuscript editor.

References

[1] M.K. Bairwa, N. Joshi, S.P. Agnihotri, Silicosis with bilateral spontaneous pneumothorax in Rajasthan, Indian J. Occup. Environ. Med. 23 (3) (2019) 112–116, https://doi.org/10.4103/ijoem.IJOEM_247_18.
[2] M. Lanzafame, S. Vento, Mini-review: silico-tuberculosis, J. clini. tubercul. other mycobact. dis. 23 (2021) 100218, https://doi.org/10.1016/j.jctube.2021.100218.
[3] T. Tsukatani, H. Niwa, T. Komori, T. Yoneyama, H. Tsuji, T. Michigishi, et al., Superior mediastinal lymphadenopathy by silicosis mimicking metastasis of papillary thyroid carcinoma - case report and literature review, Auris Nasus Larynx 47 (6) (2020) 1054–1057, https://doi.org/10.1016/j.anl.2019.12.003.
[4] M. Shafiei, A. Ghasemian, M. Eslami, F. Nojoomi, H. Rajabi-Vardanjani, Risk factors and control strategies for silicotuberculosis as an occupational disease, New microb. new infect. 27 (2019) 75–77, https://doi.org/10.1016/j.nmni.2018.11.002.
[5] R.A. Agha, T. Franchi, C. Sohrabi, G. Mathew, A. Kerwan, The SCARE 2020 guideline: updating consensus surgical CAse REport (SCARE) guidelines, Int. J. Surg. 84 (2020) 226–230, https://doi.org/10.1016/j.ijsu.2020.10.034.
[6] S. Benmerzoug, B. Bounab, S. Rose, D. Gosset, F. Biet, T. Cochard, et al., Sterile lung inflammation induced by silica exacerbates Mycobacterium tuberculosis infection via STING-dependent type 2 immunity, Cell Rep. 27 (9) (2019) 2649–2664, https://doi.org/10.1016/j.celrep.2019.04.110, e5.
[7] P. Mishra, S.E. Jacob, D. Basu, M.K. Panigrahi, V. Govindaraj, Bilateral spontaneous pneumothorax in chronic silicosis: a case report, Case rep. pathol. 2014 (2014) 561861, https://doi.org/10.1155/2014/561861.
[8] H. Barnes, N.S.L. Goh, T.L. Leong, R. Hoy, Silica-associated lung disease: an old-world exposure in modern industries, Respirology 24 (12) (2019) 1165–1175, https://doi.org/10.1111/resp.13695.
[9] N. Sharma, D. Kundu, S. Dhaked, A. Das, Silicosis and silicotuberculosis in India, Bull. World Health Organ. 94 (10) (2016) 777–778, https://doi.org/10.2471/blt.15.163550.
[10] J.K. Pandey, D. Agarwal, Biomarkers: a potential prognostic tool for silicosis, Indian J. Occup. Environ. Med. 16 (3) (2012) 101–107, https://doi.org/10.4103/0019-5278.111746.
[11] B. Sureka, A. Mittal, M.K. Mittal, B.B. Thukral, Silicotuberculosis: importance of evaluation of serial radiographs, Ann. Afr. Med. 12 (4) (2013) 255–256, https://doi.org/10.4103/1596-3519.122697.
[12] T. Sato, T. Shimosato, D.M. Klinman, Silicosis and lung cancer: current perspectives, Lung Cancer 9 (2018) 91–101, https://doi.org/10.2147/lctt.S156376.
[13] M.K. Meena, R. Singh, N. Joshi, S.S. Rathore, S. Chadalawada, M. Abubakar, et al., Silicosis with secondary spontaneous pneumothorax in the western Rajasthan, Cureus 12 (11) (2020), e11811, https://doi.org/10.7759/cureus.11811.
[14] L. Sai, X. Qi, G. Yu, J. Zhang, Y. Zheng, Q. Jia, et al., Dynamic assessing silica particle-induced pulmonary fibrosis and associated regulation of long non-coding RNA expression in Wistar rats, Gene Environ. : the off j Jpn Environ Mutagen Soc 43 (1) (2021) 23, https://doi.org/10.1186/s41021-021-00193-3.
[15] N. Iga, H. Nishi, N. Fujimoto, T. Kishimoto, Clinical features of secondary spontaneous pneumothorax complicated with silicosis, Respirat invest 56 (2) (2018) 144–149, https://doi.org/10.1016/j.resinv.2017.11.007.