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Case Report

Aluminosis pneumoconiosis presenting as hyperdense lung nodules ☆

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ABSTRACT

We present the case of a 66-year-old man who presented with new incidentally found hyperdense pulmonary nodules. Further workup with a PET/CT revealed that the nodules were FDG-avid and that there was associated hypermetabolic lymphadenopathy. Due to his history of aluminum toxicity from welding, aluminosis pneumoconiosis was suspected. Biopsy of one of the nodules was done which reinforced this diagnosis. Aluminosis pneumoconiosis is a rare occupational lung disease mostly associated with industrial workers with prolonged unprotected exposure to fine aluminum dust. Prognosis depends on the duration and intensity of exposure, and there is no definitive treatment other than eliminating further exposure.

Introduction

Aluminosis pneumoconiosis is an uncommon condition typically resulting from prolonged inhalation of aluminum-containing dust and fumes. A wide variety of industrial processing and manufacturing jobs can lead to this exposure, such as smelting, welding, polishing, or refining aluminum, or even making fireworks or other explosives [1,2].

The pulmonary effects of aluminum toxicity can vary widely. Symptoms often begin with dry cough, wheezing, and/or exertional dyspnea [2,3]. Severe cases can involve pulmonary fibrosis leading to respiratory failure or even death [3]. Supportive measures can be used to relieve symptoms, but there is ultimately no treatment at this time.

While aluminosis pneumoconiosis is rare, it should not be overlooked as a possible cause of pulmonary symptoms or radiological findings, especially when supported by a patient's occupational history. Recognizing the seriousness of this potentially fatal condition underscores the importance of awareness in the workplace about the risks of aluminum exposure and how it can be prevented using proper safety measures.

☆ Competing Interests: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Case presentation

A 66-year-old man presented with multiple pulmonary nodules found incidentally on routine presurgical chest X-ray for hip replacement (Fig. 1). Comparison to previous chest imaging from 5 years prior (Fig. 2) showed that these nodules were new. The patient had never smoked and had no personal or family history of lung cancer.

Notably, he did have a history of aluminum exposure from welding fumes with previously diagnosed aluminum toxicity 6 years prior requiring chelation therapy. Pulmonary function testing approximately 3 years prior showed mild obstruction on spirometry with a positive methacholine response.

The patient's past medical history otherwise consisted of Sjogren's, GERD, and anxiety as well as previous diagnosis of asthma. His home medications were an albuterol inhaler used occasionally and daily escitalopram oxalate. His Sjogren's and GERD were not treated with medication at this time.

Two days after his chest X-ray, a chest CT with contrast was performed (Figs. 3–7) which confirmed the presence of the nodules as well as moderate to severe upper lobe emphysema, biapical scarring, and left upper lobe granuloma.

The patient was referred to the pulmonary clinic for further evaluation and seen 1 week later. At this time, he did report increasing shortness of breath and decreased exercise tolerance. He denied any paroxysmal nocturnal dyspnea or orthopnea. He had also been experiencing cough, difficulty swallowing, and choking on food. He had not been using his albuterol inhaler as he had not noticed any improvement with it in the past. On exam, he was breathing comfort-

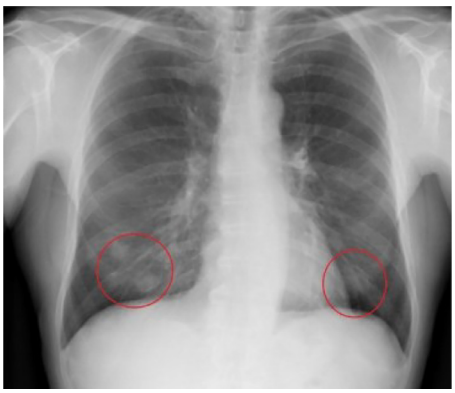

Fig. 1 – Chest X-ray showing two small nodular densities in the right lower lung zone and one in the left lower lung zone, circled in red.

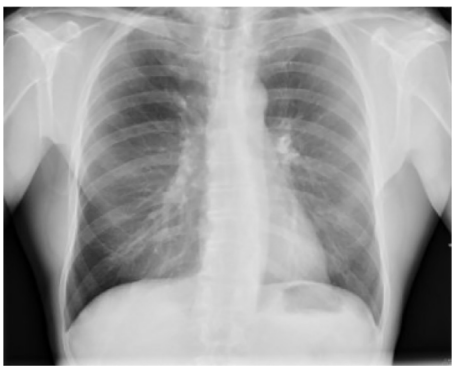

Fig. 2 – Chest X-ray from 5 years prior.

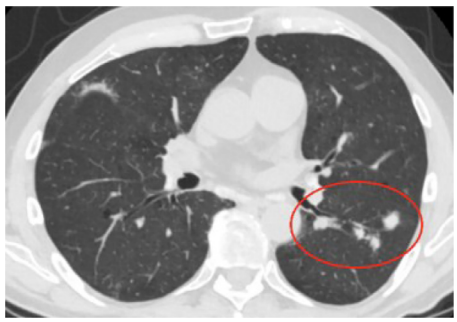

Fig. 3 – Chest CT with contrast, lung window, showing hyperdense nodular opacities in left lower lobe circled in red.

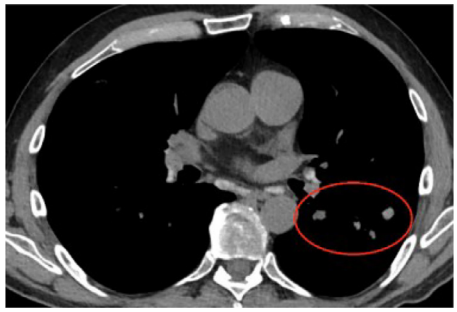

Fig. 4 – Chest CT with contrast, soft tissue window, showing hyperdense nodular opacities in left lower lobe circled in red.

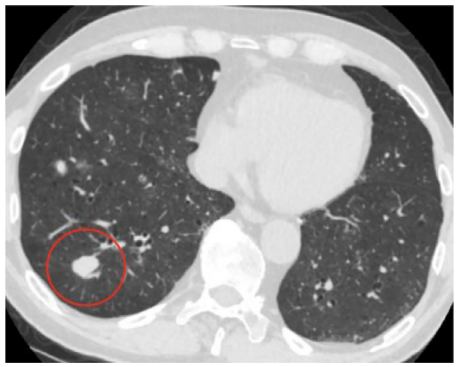

Fig. 5 – Chest CT with contrast, lung window, showing hyperdense nodular opacity in right lower lobe circled in red.

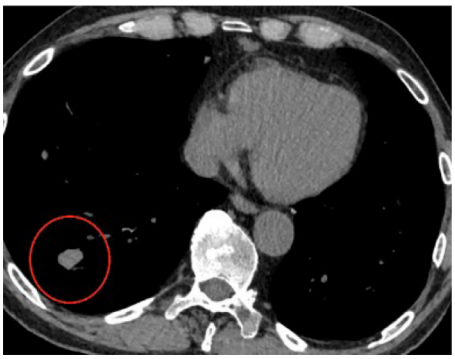

Fig. 6 – Chest CT with contrast, soft tissue window, showing hyperdense nodular opacity in right lower lobe circled in red.

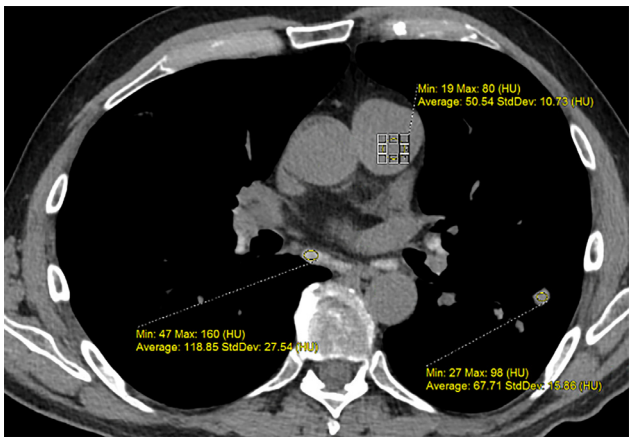

Fig. 7 – Chest CT with contrast, soft tissue window showing Hounsfield units of a blood-filled vessel, a nodule in the left lower lobe, and a lymph node. The nodule is shown to have an average reading of 67.71 Hounsfield units (HU) and the lymph node 118.85 HU, making them both hyperdense in comparison to the 50.54 HU measured in the blood.

ably on room air and his lungs were clear to auscultation bilaterally.

New pulmonary function testing found worsened obstruction on spirometry with no response to bronchodilator as well as decreased FEV1 and DLCO compared to prior.

Approximately one week later, he underwent a PET/CT which found the nodules to be FDG avid (Fig. 8). Bilateral hilar, subcarinal, and left axillary lymphadenopathy was noted with mild hypermetabolic activity (Fig. 9).

The patient underwent CT-guided biopsy of one of the nodules found in the right lower lobe (Fig. 8). The pathology report stated that the specimen was consistent with non-necrotizing granulomatous inflammation and contained macrophages with small gray dust-like refractile particles within the cytoplasm. They noted that the histologic pattern was similar to that seen in aluminosis.

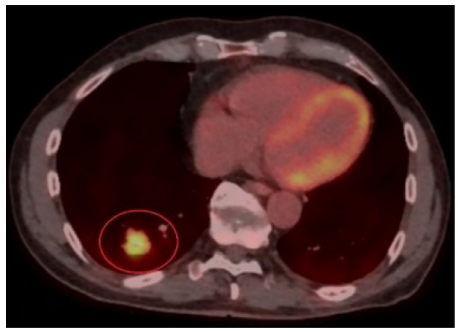

Fig. 8 – PET/CT showing FDG-avid nodule in right lower lobe, circled in red. Nodule SUV max 7.0; background mediastinal blood pool SUV max 2.1.

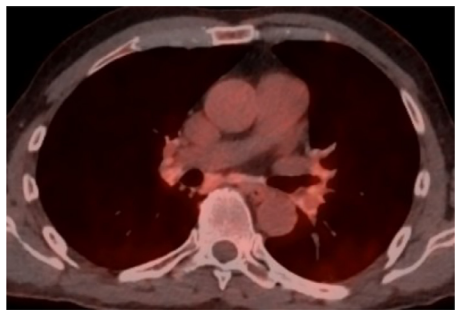

Fig. 9 – PET/CT showing bilateral lymphadenopathy with hypermetabolic activity.

Discussion

Aluminosis pneumoconiosis is a type of occupational lung disease caused by prolonged exposure to aluminum dust and fumes [4]. It primarily affects industrial workers who are regularly exposed to aluminum particles during activities like welding and smelting [2,4]. The pathogenesis is not fully understood; however, it is known that particles deposit in the lungs and cause subsequent inflammation and fibrosis [1]. Aluminosis pneumoconiosis can present with nonspecific symptoms such as coughing, shortness of breath, and chest discomfort [3].

On imaging, the appearance of aluminosis pneumoconiosis varies. In earliest stages, HRCT findings often include alveolitis and small ill-defined centrilobular opacities [4–6]. As the disease progresses, it typically appears as upper lobe nodules and/or diffuse pulmonary fibrosis [3,5,6]. Emphysematous changes and honeycombing may also be present [3,5]. HRCT can be used to detect the very earliest stages of aluminosis before any progression to fibrosis [4].

Notably, this patient's imaging findings are not specific to aluminosis pneumoconiosis. Hyperdense nodules have a variety of possible etiologies, including other pneumoconioses, fungal/mycobacterial infection, hamartoma, carcinoid, amyloid, sarcoidosis, diffuse pulmonary ossification, talcosis, amiodarone toxicity, and cancer [4,7,8]. Therefore, it is impor-

tant to interpret imaging in the context of the patient's history and exposures.

There is no definitive medical treatment or cure for aluminum pneumoconiosis [3]. The prognosis of this condition varies depending on factors such as the level and duration of aluminum exposure [3,9]. Removing the affected individual from further exposure is critical to prevent disease progression. Unfortunately, once fibrosis has begun, it can continue to progress even after exposure is stopped [4]. Supportive treatments such as oxygen therapy and bronchodilators can also be used to alleviate symptoms [9]. Progression of the condition can be monitored with periodic imaging and lung function testing.

Patient consent

Written, informed consent was obtained from the patient for publication of this case report. They understand the purpose of publishing the case for review by physicians and other healthcare professionals. The patient is aware that their relevant medical information and images will be presented as part of the publication, but that their identity will not be disclosed and every attempt will be made to ensure anonymity.

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