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Stéphanie Moisan-Templereau, Pierre Rucay, Alaa Ghali, Dominique Penneau-Fontbonne, Christian Lavigne

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Case report

Silica-associated limited systemic sclerosis after occupational exposure to calcined diatomaceous earth

Stéphanie Moisan [a], Pierre Rucay [a,*], Alaa Ghali [b], Dominique Penneau-Fontbonne [c], Christian Lavigne [b]

[a] *Service de santé au travail, CHU d'Angers, 4, rue Larrey, 49933 Angers cedex 9, France*
[b] *Département de médecine interne et gérontologie, CHU d'Angers, 4, rue Larrey, 49933 Angers cedex 9, France*
[c] *Service de médecine interne et pathologie professionnelle, CHU d'Angers, 4, rue Larrey, 49933 Angers cedex 9, France*

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ABSTRACT

Silica-associated systemic sclerosis can occur in persons using calcined diatomaceous earth for filtration purpose. A limited systemic sclerosis was diagnosed in a 52-year-old male winegrower who had a combination of Raynaud's phenomenon, oesophageal dysfunction, sclerodactyly and telangectasia. The anti-centromere antibodies titre was 1/5000. The patient was frequently exposed to high atmospheric concentrations of calcined diatomaceous earth when performing the filtration of wines. Calcined diatomaceous earth is almost pure crystalline silica under the cristobalite form. The diagnosis of silica-associated limited systemic sclerosis after exposure to calcined diatomaceous earth was made. The patient's disease met the medical, administrative and occupational criteria given in the occupational diseases list 22 bis of the agriculture Social Security scheme and thence was presumed to be occupational in origin, without need to be proved. The diagnosis of occupational disease had been recognized by the compensation system of the agricultural health insurance.

1. Introduction

Systemic sclerosis (SSc) is a rare systemic connective tissue disease. The reported incidence rates vary between 4.5 and 18.7 new cases per million in the USA and European countries [1,2]. The disease is predominant in females, with a female to male ratio of 5–14:1 [2]. SSc has many different presentations involving the skin, internal organs and blood vessels' walls [3]. It is characterized by an excessive collagen deposition in tissues [4], immunologic system disturbances [5] and vascular changes. Many factors including genetic and environmental factors are involved in the pathogenesis of SSc [6]. Environmental factors known to trigger the occurrence of SSc are crystalline silica, organic solvents, epoxy resins, vinyl chloride, pesticides, etc [7,8]. Workers with occupational exposure to these environmental factors are principally those who are working in mining or other industrial sectors. In this case report we however present a case of limited SSc (lSSc) [9] in a male winegrower after occupational exposure to calcined diatomaceous earth (DE).

2. Case report

A 52-year-old male patient was admitted to the department of internal medicine for Raynaud's phenomenon of 1-year duration. The initial physical examination revealed swollen fingers that rapidly progressed to sclerodactyly during hospitalization, associated with telangiectasia and fingertips ulcerations. Nailfold capillaroscopy showed a capillary dropout with no capillary loops dilatation; hand X-rays did not show calcinosis. The upper endoscopy, performed to investigate heartburn symptoms, revealed a wide opening of the lower esophageal sphincter but no oesophagitis. Other explorations revealed no evidence of pulmonary, renal, cardiac or extensive digestive system involvement. Only two abnormal laboratory findings were noted: anti-centromere antibodies (ACA) at a titre of 1/5000 and a polyclonal hypergammaglobulinemia.

Over his professional life, the patient was working as winegrower and he was frequently performing wines' filtration for 25 years. This procedure aims at clarifying wines by removing particulates such as yeast, bacteria and other grape solids. The patient had used the cake filtration system, and had utilized calcined DE for precoating of the filter pads as well as for a continuous feed throughout the filtration cycle, in order to improve the filtration system characteristics. By selecting the particle size of the calcined DE, different fineness of filtration could be achieved. Before and during the filtration procedure, the patient has been exposed to high atmospheric concentrations of calcined DE by handling it in a non-ventilated room and without using any respiratory protective system. The patient has not been exposed to any other toxic substance during his professional life or leisure activities.

* Corresponding author. Tel.: +33 (0) 2 41 35 38 25; fax: +33 (0) 2 41 35 53 36.
E-mail address: pirucay@chu-angers.fr (P. Rucay).

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3. Discussion

We report the case of a patient having a combination of Raynaud's phenomenon, oesophageal dysfunction, sclerodactyly and telangectasia. These are four of the five criteria of the CREST syndrome (calcinosis is missing) as defined by Winterbauer in 1964 [10]. Therefore, we could conclude that the patient had a limited SSc (lSSc). The presence of a high titre of ACA, which are closely associated with lSSc, supported the diagnosis. The prognosis of SSc depends on the extent of the skin lesions, which correlates with the severity of the cardiovascular, pulmonary and renal manifestations. It is also directly related to the auto-antibody pattern. Pulmonary arterial hypertension is less frequent among patients with lSSc and its onset is delayed when associated with ACA. On the contrary, anti-topoisomerase (anti-Scl 70) antibodies are associated with interstitial lung disease, and anti-RNA polymerase III antibodies with renovascular hypertension. Ten-year survival in patients with lSSc is 75% when associated with ACA [11]. Therefore, we can expect a good prognosis for our patient, in whom lSSc symptoms are no more worsening since 1-year. Calcined DE is the only detrimental environmental factor to which the patient has been exposed. DE is a mineral derived from the skeletal remains of diatoms that are deposited on marine and lake floors. These microscopic plants extract silica from the water under its amorphous (non-crystalline) form. DE is processed at 800–1000 °C to burn off all organic matter. This leaves a residue, the calcined DE, which is almost pure crystalline silica under the cristobalite form [12]. There are various grades of calcined DE depending on the fineness or particle size, which range from about 2.5 to 38 μm. The finer particle size produces a more polished filtration. The diagnosis of silica-associated lSSc in our patient was established on the basis of repeated exposures to crystalline silica, in form of calcined DE. Among other employees, the patient was the only one exposed to DE. Nobody except him developed the disease. Women have higher rates of SSc compared to men, but most documented cases of silica-related SSc concerned men, as is the case in our observation [13]. This reinforces the hypothesis of a possible association between an occupational exposure to crystalline silica and the occurrence of lSSc. A significant association between toxic exposures, notably to crystalline silica, and severity of SSc is reported in the literature [14], but this association could not be confirmed in our observation. Silica-induced autoimmune disorders have been explained as adjuvant-type effects of silica. Recent advances in immunomolecular studies led to detailed analyses of the immunological effects of silica. Silica involves immuno-competent cells resulting in effects that may be associated with the pathophysiological development of complications in silica-exposed persons such as the occurrence of autoimmune disorders. Autoantibodies against topoisomerase I, desmoglein, caspase-8 and Fas were detected in silicosis patients' sera. The last two antibodies may be of interest because the target molecules have a key role during apoptosis processing in lymphocytes. Fas (CD95) is mainly expressed on the cell membrane of lymphocytes, and antibodies against Fas induce Fas-mediated apoptosis of membrane-Fas-expressing cells [15]. Patient's disease appears on the occupational diseases list 22 bis of the agriculture Social Security scheme, without necessarily being associated with silicosis "Erasmus syndrome". The patient responds to the time limit of 15 years required for compensation claims as well as to the 10-year minimum duration of exposure to crystalline silica dust. Patient's work is included in the indicative list (22 bis), which enumerates the occupations susceptible to cause SSc. The patient's disease, lSSc, meets therefore the medical, administrative and occupational criteria given in list 22 bis and thence is presumed to be occupational in origin, without need to be proved. The diagnosis of occupational disease has been recognized by the compensation system of the agricultural health insurance.

Exposure to crystalline silica should be looked for in persons employed in wine or cider production, in whom the diagnosis of SSc is made. These persons may be exposed to silica through the manipulation of calcined DE. Because of its environmental impact and health effects, the substitution of calcined DE based filtration systems by other systems like those using microfiltration membranes could be recommended. This may however be declined by professionals of the wine or cider industry, because most of them consider that calcined DE is the best filtration material.

Conflicts of interest statement

None of the authors has any conflicts of interest to declare.

All authors agree to the content, presentation and decision to submit the manuscript.

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