Interstitial pneumonia following exposure to fluorocarbon polymers

Pneumonia intersticial após exposição a polímeros fluorocarbonados

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To the Editor:

Perfluoroalkyl resins are compounds containing hydrophobic alkyl chains, which are partially or fully fluorinated. These resins are heat-resistant (up to 260°C) thermoplastics used as coatings in the metallurgical industry (because of their mechanical and anti-adhesive resistance), as waterproofing agents for coating fabric, in papers used in the food industry, and in surface-active products, waxes, and insecticide formulations. As waterproofing agents, these resins are applied by manually-compressed or motorized spraying systems or by sprays. Reports of respiratory symptoms or epidemics in countries in Europe, Asia, and North America, totaling a few hundred cases, are summarized in a 2009 document by the Public Health Agency of Switzerland.[1] The cases include patients with varying degrees of clinical impairment. We report the first case of interstitial pneumonia caused by exposure to fluorocarbon resins in Brazil.

A 21-year-old male nonsmoker with interstitial pneumonia and no history of respiratory disease was evaluated at our facility. One year earlier, the patient was employed at a furniture factory specializing in the manufacture of sofas and armchairs. He worked as a sofa assembler for three months. Subsequently, he was transferred to an adjacent room, where he filled cushions with synthetic flakes and foams. In that same room, a coworker performed the waterproofing of the fabrics by using a manually-compressed spraying system (Figure 1). The work area was a rectangular enclosure of 30 m^2, with no ventilation/exhaust system, where there were waterproofing product mists. One week later, he had flu-like symptoms that resolved with withdrawal from the workplace. When he returned to work, he developed progressive dyspnea and cough, followed by limitation of physical activities, such as playing soccer and climbing stairs. One month later, he sought treatment from a cardiologist, who started clinical investigation. He continued to work, and the symptoms gradually worsened. Three months later, he had sudden pain in the left hemithorax with worsening dyspnea, a pneumothorax was diagnosed, and there was a finding of diffuse ground-glass infiltration (Figure 2A). Twelve days later, drainage resulted in unsatisfactory lung expansion, and the patient underwent thoracotomy and lung biopsy, which revealed desquamative interstitial pneumonia (Figures 2B and 2C). One month later, he was asymptomatic. A follow-up CT scan showed apical and subpleural bullae and a band in the left hemithorax, which was associated with the area of previous surgical manipulation. His alpha-1-antitrypsin level was normal (183 mg/dL). The patient was started on a 45-day course of prednisone. Spirometry showed that FVC increased from 43%, before the pneumothorax episode, to 72%, twelve months later.

The onset of the condition occurred when the patient was indirectly exposed to waterproofing product mists, the waterproofing agent (Teximper®; Teximper Comércio Importação e Exportação Ltda, São Paulo, Brazil) being composed of perfluoroalkyl resin in a solvent. The parenchymal inflammation was only identified after the pneumothorax. The patient's history included acute, short-term, flu-like symptoms, which started a few days after the change of sectors, followed by progressive dyspnea and cough, which lasted for weeks prior to hospitalization.

Exposure to fumes from fluorocarbon polymers was first described as a cause of flu-like symptoms related to products of thermal degradation of polytetrafluoroethylene (PTFE or Teflon®), being designated "polymer fume fever".[2] Subsequently, cases of respiratory symptoms related to industrial or household exposure to fluorocarbon polymers were described.[1] Waterproofing agents contain fluorocarbon resins, silicones, or waxes as active elements. They are used in the form of sprays—the main use of which is to waterproof shoes. These sprays contain a propellant gas, a resin, and a solvent. When they are applied, the solvent

evaporates and the resin adheres to the fabric. Heinzer et al.[3] reported 6 cases of patients hospitalized for respiratory failure following household exposure between January and March of 2003 in Switzerland. The products used were of different brands; however, a little earlier, the resin supplier had changed the solvent to heptane. During the months in which the new formulation was used, 153 cases of respiratory symptoms were reported in Switzerland.

The mechanism of pulmonary toxicity is unknown. An experimental study raised the hypothesis of a direct effect on the surfactant, because of polymer deposition on the alveolar wall, increasing the surface tension and leading to collapse.[4] A retrospective study evaluated 102 cases of individuals who had respiratory symptoms following household exposure to sprays of acrylic fluorocarbon resins.[5] Those authors concluded that the findings could not be attributed to the solvent present in the formulation because of the high volatility of that solvent, and that the clinical repercussions showed no association with the magnitude of the exposure, or with personal histories of smoking, atopy, and chronic lung disease. Apparently, there is an association between resin toxicity and resin particle diameter.[6] This diameter is a function of the spray generation mechanism (spray systems generate a greater mass of particulate matter < 10 μm than do pump systems) and the solvent (fast-evaporating solvents, such as heptane, generate a greater amount of small-sized particulate matter).[1]

Figure 1 - Manually-compressed resin spraying system with a discharge valve. Note the presence of droplets on the lens of the camera as a result of the product spray.

The CT images described in other case reports[3,7] are similar to the findings of the present case. Histology showed extensive areas of alveolar collapse, without a significant accumulation of intra-alveolar macrophages, and with strong staining of pneumocytes. Wallace & Brown[7] and Ota et al.[8] reported similar findings in cases of patients who underwent transbronchial biopsy.

Most of the cases reported or registered in centers for the treatment of intoxication were cured, either spontaneously or with corticosteroid therapy. There have been few reports of cases in which the DLCO remained abnormal and fibrosis was established.[7,9] Three deaths have been reported.[5,8,10]

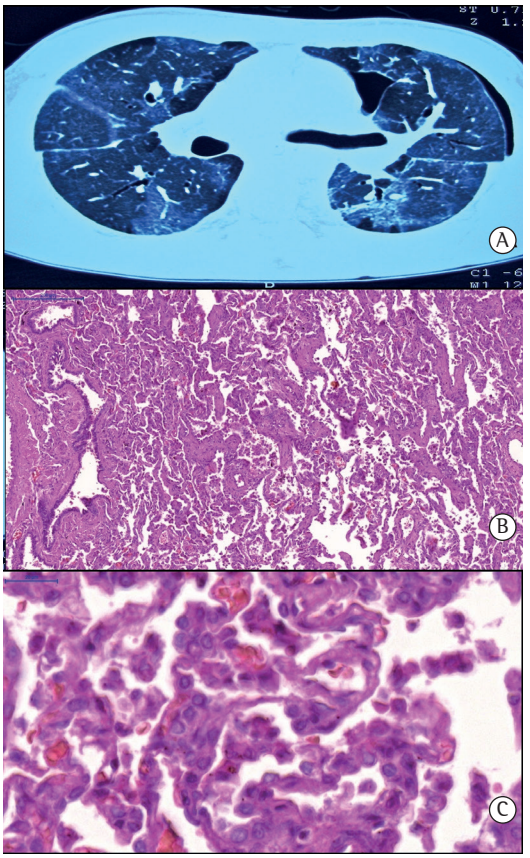

Figure 2 - In A, an HRCT scan showing left pneumothorax and extensive bilateral areas of ground-glass attenuation. In B, findings of desquamative interstitial pneumonitis on histology of an open lung biopsy sample, revealing that the architecture of the lung parenchyma and small airways is intact, with mild interstitial thickening. There are areas of alveolar filling with pooled alveolar macrophages, without granuloma formation (H&E; scale bar, 200 μm). In C, detail of Figure 2B showing alveolar septa with reactive pneumocytes and intra-alveolar macrophage accumulation (H&E; scale bar, 20 μm).

In Brazil, waterproofing sprays for shoes are sold in shoe stores, and the practice of waterproofing upholstered chairs and sofas is common. Items containing Teflon® are also present in households. Little is said about the toxicity of these products, toxicity that might be associated with chemical pneumonias caused by inhalation of aerosols containing fluorocarbon polymers.

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