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CASE REPORT

Pulmonary Injury from Waterproofing Spray During a Hike

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A 48-year-old man developed general fatigue, dyspnea, and fever at an altitude of 1562 m from the morning of the first day of a 3-day hike. Despite pharyngeal discomfort and mild general fatigue, he felt that the symptoms were not sufficient to abandon his plan. He usually required 1.5 hours to reach Tokusawa (6.4 km from the starting point at an altitude of 1500 m), but this time he required 2.5 hours and slept briefly upon arrival at Tokusawa due to extreme fatigue and respiratory discomfort. His symptoms became aggravated, so he presented at a mountain clinic with oxygen saturation at 80% and body temperature of 37.6ºC. He was diagnosed with hypoxemia due to pneumonia and/or other disease(s) and was evacuated to a hospital where a chest computed tomography scan revealed ground glass opacity and infiltrative shadows. He was treated for pneumonia, but another doctor discovered during follow-up that the patient had sprayed 300 mL of a waterproofing aerosol on mountain equipment in a nonventilated, enclosed area of his home on the night before starting out on the hike. Therefore, waterproofing spray was considered to have caused pulmonary damage. Self-reporting or appropriate questionnaires are the only means of identifying this type of injury. The differential diagnosis of pulmonary problems in an outdoor setting should include toxic aerosol exposure from waterproofing spray.

Keywords: waterproofing spray, aerosol, pulmonary injury, hiking

Introduction

Protection against becoming wet is essential for safe and comfortable outdoor activities.[1,2] Waterproofing or leather protector compounds containing fluoropolymers, silicone resins, petroleum hydrocarbons, or other solvents are sprayed onto surfaces to repel water and dirt. However, these products can cause acute lung injury when applied in poorly ventilated areas.[3–5] The elapsed time to development of symptoms such as shortness of breath, chest tightness/pain, dry cough, throat pain, headache, nausea/vomiting, fever, lightheaded/dizziness, and general fatigue and fever varies from <15 minutes to 24 hours after inhaling an aerosol.[4,6–9] However, leisure activities in remote areas could proceed before symptoms of delayed onset appear or worsen.

We describe a patient presenting with pharyngeal discomfort, general fatigue, respiratory discomfort, and fever that developed while hiking at an altitude of 1562 m. He was initially diagnosed with hypoxemia due to pneumonia and/or other disease(s), but further information suggested that inhaling 300 mL of waterproofing spray caused the pulmonary damage.

Case Report

A 48-year-old Japanese man presented with pharyngeal discomfort, general fatigue, dyspnea, and fever at a

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mountain clinic located at an altitude of 1562 m in the Japanese Northern Alps on the first day of a 3-day hike.

He had felt pharyngeal discomfort and mild general fatigue from the morning of the day he left his Tokyo residence, which was essentially at sea level. He did not consider his consumption of 360 mL of Japanese sake on the previous evening to be a factor because he habitually consumed that amount. He felt that something was wrong, but the symptoms were not sufficient to abandon his plan to climb Mt. Yari (altitude 3180 m). He travelled with a friend by public transport to Kamikochi (altitude 1500 m), a starting point for the Japanese Northern Alps. He became unable to walk at normal speed soon after starting the hike. He usually walked faster than this friend, but he was slower than his friend on that day and needed 2.5 hours to reach Tokusawa (altitude 1562 m; distance 6.4 km from Kamikochi) instead of the usual 1.5 hours. After walking for about 1 hour, he found that he could not continue without brief stops due to worsening fatigue and respiratory discomfort. Therefore, they changed their destination for the first day to Tokusawa instead of Yarisawa (altitude 1820 m; another 2.5 hours from Tokusawa). The patient's symptoms became aggravated after sleeping briefly at Tokusawa, and he felt very hot. He assessed himself as having a cold and asked his friend to borrow a thermometer at the front desk of a mountain lodge. The manager of the mountain lodge then referred him to medical care.

He presented at a mountain clinic during the evening, about 2 hours after arriving in Tokusawa. He had a history of infectious mononucleosis and a pyrine allergy. He had smoked 20 cigarettes/day for 20 years but had stopped 2 years previously. He had 30 years of mountaineering/hiking experience. The initial findings were as follows: blood pressure 114/68 mm Hg; pulse 106 beats/min; body temperature 37.6ºC; oxygen saturation (SpO_2) 80–83% in room air; no cyanosis; clear respiratory sounds; and no obvious dry or moist rales, heart murmur, or edema of the extremities. Portable electrocardiography confirmed normal sinus rhythm. The doctors diagnosed hypoxemia due to pneumonia and/or other disease(s) and suggested an emergency descent. He was given 3 L/min of oxygen, and SpO_2 immediately increased to 92%. While waiting 1 hour for evacuation, SpO_2 further increased to 96–98%, his pulse decreased to 90 beats/min, and his general fatigue improved.

Examination upon admission to a suburban hospital (altitude 690 m) revealed a pulse of 80 beats/min and SpO_2 of 100% upon administration of 3 L/min oxygen. Laboratory findings showed elevated white blood cells and C-reactive protein and decreased arterial partial pressure of oxygen without decreased partial pressure of carbon dioxide (Table). Chest computed tomography images revealed diffuse ground glass opacities in bilateral lung fields and infiltrative shadows in bilateral lower lung fields, indicating atypical pneumonia (Figure). Procalcitonin was also increased, and bacterial pneumonia was suspected (Table). Urinary antigen tests for *Legionella pneumophila* and *Streptococcus pneumoniae* and the pharyngeal influenza virus antigen rapid test were all negative.

He was treated with 2 L/min of oxygen inhalation and intravenous sulbactam/ampicillin. The SpO_2 improved to 95% in room air on hospital day 3, and he was discharged because of the demands of his job. He attended his general physician in Tokyo for follow-up as recommended by the doctor at the suburban hospital. His general physician then referred him to a respiratory disease specialist at a university hospital. A chest radiograph upon arrival at the university hospital confirmed that his lungs were clear of pneumonia, and he was advised to rest for 4 more days.

Table. Laboratory data at suburban hospital on day of symptom manifestation

Laboratory test	*Results*
Complete blood count	
WBC	17,200/μL
Neut	83.9%
Lym	12.7%
Mon	3.2%
Eos	0.1%
Bas	0.1%
RBC	4.20×10^6/μL
Hb	13.9 g/dL
Hct	38.6%
PLT	19.4×10^4/mL
Selologic tests	
CRP	9.36 mg/dL
Procalcitonin	6.33 ng/mL
Blood gas analysis	
pH	7.421
pCO_2	39.2 mm Hg
pO_2	73.2 mm Hg
HCO_3^-	25 mEq/L
BE	1.1 mEq/L
Antigen tests	
Urinary tests	
Streptococcus Pneumoniae	–
Legionella Pneumophilla	–
Pharyngeal test	
Influenza virus	–

WBC, white blood cells; Neut, neutrophils; Lym, lymphocytes; Mon, monocytes; Eos, eosinophils; Bas, basophils; RBC, red blood cells; Hb, hemoglobin; Hct, hematocrit; PLT, platelets; CRP, C-reactive protein; pCO_2, partial pressure of carbon dioxide; pO_2, partial pressure of oxygen; HCO_3^-, bicarbonate; BE, base excess.