High-Altitude Acute Pulmonary Edema after 48 Hours in a Ski Station☆

Edema agudo de pulmón por altura tras 48 horas de estancia en una estación de esquí

To the Editor,

Acute non-cardiogenic pulmonary edema consists of the rapid appearance of alveolar edema for causes other than increased pulmonary capillary pressure.[1] One of the etiologies of this entity is acute high-altitude pulmonary edema (HAPE), an uncommon but potentially fatal presentation (50% mortality in untreated patients).

It is one of the so-called "altitude sicknesses", the benign form of which occurs in 75% of the population exposed to an altitude of between 2500 and 3000 m, manifesting as symptoms such as nausea, vomiting, asthenia, anorexia, headache, dizziness, sleep disturbances or even dyspnea. The malignant form is less frequent, and develops with acute pulmonary edema and/or cerebral edema syndrome.[2]

We report the case of a 40-year-old white man with no significant clinical history, regular athlete, former smoker, normally resident at about 11 m above sea level, who had ascended to Sierra Nevada (maximum height 3300 m) in less than 3 h. He skied intensively for a 48 h period before experiencing a feeling of tiredness that forced him to interrupt his activity.

He notified the emergency department of the ski resort of symptoms of sudden dyspnea, more intense in the supine position, and cough with bubbly pinkish expectoration. On arrival in the medical center, the patient was normotensive, with signs of hypoperfusion and cyanosis, tachycardiac at 120 bpm, tachypneic (>30 breaths/min), with $SatO_2$ of around 90% and FiO_2 of 0.6 with work of breathing and low-grade fever of 37 °C. Auscultation revealed moist rales, mainly in both lung bases. ECG showed sinus tachycardia at 110 bpm with normal axis along with the ST depression in the inferior and anteroseptal aspects. After administration of empirical treatment (oxygen therapy by reservoir cannula with FiO_2 of 1.0, furosemide, acetylsalicylic acid and antibiotic coverage), the patient was transferred to the tertiary hospital.

On arrival at the hospital, arterial blood gases (FiO_2 0.6) were determined, showing normal pH, oxygen partial pressure of 69.9 mmHg, and normal carbon dioxide and lactic acid. Clinical laboratory tests were significant for slightly raised CRP and leukocytosis with neutrophilia, with normal D-dimer and cardiac markers.

Chest X-ray showed a normal cardiothoracic index with a bilateral reticular cotton–wool pattern with no central predominance (Fig. 1). The CT-angiogram ruled out pulmonary thromboembolism and concluded findings indicative of acute pulmonary edema. Alveolar opacities and ground glass opacities were also observed, with a symmetrical, generalized distribution in the parenchyma of both lungs, slightly more predominantly in the lower lobes, which showed thickening of the interlobular septa and a significant increase in pulmonary arterial trunk diameter (35 mm) (Fig. 1).

Transthoracic echocardiogram showed signs of pulmonary hypertension with slight tricuspid insufficiency and an estimated 70 mmHg systolic pressure in the pulmonary artery, without pericardial effusion.

The patient was admitted to the ward, and his oxygen requirements decreased progressively in the first 24 h. Treatment continued with the patient placed in a sitting position, receiving low-flow oxygen therapy (nasal prongs at 2 l/min), and minimum-dose furosemide. After 3 days of hospitalization, he was completely asymptomatic at discharge. Follow-up echocardiography and cardiopulmonary exertion test one year later were both normal.

HAPE generally occurs within 2–5 days after arrival at high altitudes, and around 50% of cases are associated with acute mountain sickness. High altitude is considered to be between 1500 and 3700 m, 3700–5500 m very high (the incidence of HAPE at this altitude is 0.6–6%), and >5500 m extreme (2–15%).[3]

Onset of clinical symptoms is insidious, with decreased exercise tolerance, progressive dyspnea, orthopnea, wet cough, hemoptysis, chest pain, headache, and confusion.[3,4] Saturation is estimated to be 10% lower than expected according to the altitude, and the patient's general status is usually better than expected from their level of hypoxemia.[4]

The main risk factor is individual susceptibility due to a low hypoxic ventilatory response.[5]The risk factor most susceptible to modification is the rate of ascent,[6] and altitude gained during sleep is more significant than that gained during the day. Other factors include the intensity of the exercise (more than the exercise itself), male sex, anxiolytic medication, and low temperatures. A previous episode of HAPE carries a risk of recurrence of 60%, so it is very important that the patient is warned. A gradual ascent of about 500 m per day to levels above 2500 m allows the physiological processes in the body to compensate adequately for the reduced partial

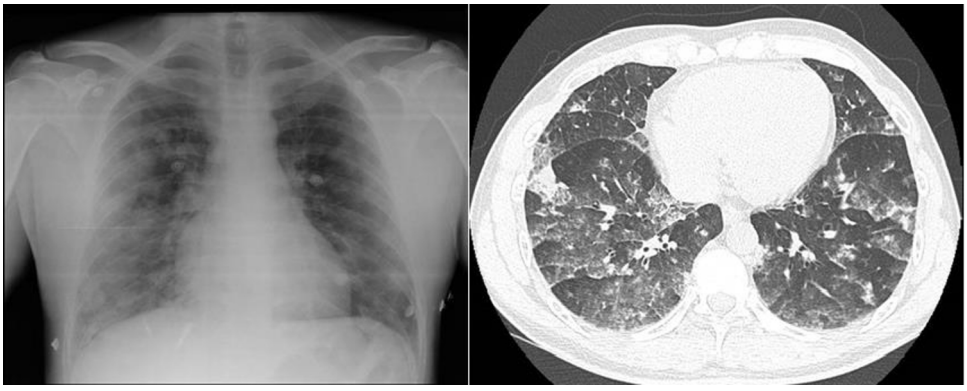

Fig. 1. On the left, chest X-ray with bilateral reticular cotton–wool infiltrates. On the right, CT-angiogram (parenchymal window) showing alveolar and ground glass opacities in both lungs.

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pressure of oxygen at the new altitude. Avoiding exercise and alcohol during the first 48 h until acclimatization also minimizes the risk. Pre-existing conditions that lead to increased pulmonary blood flow, such as pulmonary hypertension, increased pulmonary vascular reactivity, or a patent foramen ovale, are predisposing factors for the appearance of the HAPE.

The key factor in the pathophysiology of the disease is the initial adaptation to altitude, in which the individual will typically increase ventilation. Activation of the pulmonary and cerebral hypoxic vasoconstriction reflex results in an exaggerated vasoconstriction response, raising pulmonary artery systolic pressure.[3] The subsequent transudative capillary leak and the increase in perfusion increase blood pressure and hydrostatic pressure, causing damage to the alveolar–capillary barrier, and ultimately, increased vascular permeability leading to acute, non-uniform pulmonary edema.

Treatment consists of oxygen therapy and descending around 1000 m or to a level where symptoms resolve, minimizing exertion during the descent. Pharmacological treatment mentioned in the literature includes vasodilators, such as nifedipine (dihydropyridinic calcium channel blocker antagonists)[4] or sildenafil,[3] phosphodiesterase inhibitors,[4] and dexamethasone. Acetazolamide is also used as a treatment because it creates alkalemia, which leads to increased ventilation by increasing the arterial oxygen content of blood, and study is ongoing into its prophylactic use for ascents to more than 2700 m.[3,6,7] Potential new therapies, such as ibuprofen, nitrates, and intravenous iron supplements are recommended.[3]

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Pulmonary Necrobiotic Nodules: A Rare Manifestation of Crohn's Disease☆

Nódulos necrobióticos pulmonares: una manifestación excepcional de la enfermedad de Crohn

To the Editor,

The most unusual extraintestinal manifestations of inflammatory bowel disease (IBD) are respiratory, and ulcerative colitis (UC) is the most common causative entity. Clinical presentation is variable, ranging from asymptomatic patients to cases that present with cough, dyspnea, and respiratory failure. One peculiar characteristic is that pulmonary involvement does not always occur in parallel to intestinal tract disease, making it difficult to diagnosis. Pulmonary necrobiotic nodules as pulmonary complications of Crohn's disease (CD) are an exceptional manifestation, calling for a differential diagnosis with neoplastic diseases and infectious diseases, characterized by an excellent response to treatment with corticosteroids. Very few cases have been reported in the literature on this entity, and all of them presented with pulmonary symptoms, such as cough and dyspnea. We report the case of a patient with CD without respiratory manifestations, in whom pulmonary necrobiotic nodules were an incidental radiological finding.

A 26-year-old woman consulted for diarrhea, with a 2-year history of 6–10 stools per day of liquid consistency with blood and mucus, abdominal pain, and weight loss. She was a smoker of 10 cigarettes a day and had no other clinical history of interest. Physical examination revealed poor general condition and painful abdomen on palpation in the epigastrium. Cardiopulmonary auscultation was normal, and no adenopathies or skin lesions were observed. Clinical laboratory tests were significant for hemoglobin 10.5 g/dl and transferrin saturation 5.1%, platelets 393 000/ml, and eosinophils 1000/ml. Chest radiograph was normal. Stool cultures at the time of the study were negative. Ileocolonoscopy showed swollen and erythematous mucosa with crater-like, serpiginous ulcers alternating with normal mucosa. The pathology report was suggestive of CD. Treatment began with oral budesonide 9 mg/day and mesalazine 2 g/day, with clinical improvement.

The patient's digestive symptoms subsequently improved, but lobar pneumonia developed, which was treated with levofloxacin. However, several lung nodules measuring 8–10 mm in diameter were identified in the X-ray performed to monitor radiological progress when the respiratory symptoms had resolved, and confirmed on a chest CT scan (Fig. 1). Bronchoscopy was normal with no tumor cells or pathogens in bronchoalveolar lavage (BAL). Other diagnoses, including metastasis and abscesses, were considered in the differential diagnosis. The diagnosis of pulmonary necrobiotic nodules associated with CD was given, in view of the temporal relationship between the diagnosis and IBD flare-up, and the good condition of the patient. She was treated with systemic corticosteroids, and radiological resolution of the nodules was achieved after 1 month of treatment (Fig. 1).

IBD is a chronic inflammation of unknown etiology, which affects the digestive tract. Pathogenesis is due to a recurrent inadequate response of the mucosal immune system, activated by the presence of normal luminal flora in genetically predisposed individuals. It is histologically characterized by a lymphocytic polymorphonuclear infiltrate with formation of granulomas, ulcers, and fissures in the mucosa. Although it mainly affects the intestine,

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