

DIAGNOSTIC CHALLENGE

Answer

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The correct answer to this Diagnostic Challenge is swimming-induced pulmonary edema (SIPE).

Cardiogenic pulmonary edema is an unlikely diagnosis in this case. Even without knowing the results of serial troponin determinations, the diagnosis of acute myocardial infarction leading to severe congestive heart failure would be almost impossible with a normal ECG; and as indicated below. Of note, a delayed echocardiogram revealed a normal ejection fraction, suggesting a non-cardiogenic etiology.

Food-associated, exercise-induced anaphylaxis has been described,<sup>1</sup> especially in teenaged women, and it can produce pulmonary edema;<sup>2</sup> however, this patient lacked wheals and gastrointestinal symptoms, as well as vascular collapse, which are key features of the syndrome.

Cold urticaria may often involve the respiratory tract (hoarseness, dyspnea and wheezing), gastrointestinal and the cardiovascular systems (hypotension, tachycardia and arrhythmia),<sup>3</sup> and shock-like symptoms have been reported after aquatic exposures.<sup>4,5</sup> However, most typically patients with this condition develop diffuse pruritus and wheals with angioedema,<sup>3</sup> and our patient had none of these manifestations.

Commentary

In racing thoroughbreds, marked increases in pulmonary vascular pressures contribute to stress failure of pulmonary capillaries<sup>6,7</sup> causing lung bleeding. After brief, vigorous exercise in elite human athletes with a previous history suggestive of lung bleeding, increased concentrations of red blood cells and protein have been demonstrated in broncho-alveolar lavage fluid. These findings imply that

intense exercise can impair the integrity of the pulmonary capillaries of the blood–gas barrier (BGB).<sup>8</sup> Chest CT scans of highly trained athletes after a triathlon competition demonstrated enhanced lung density and greater numbers of opacities suggesting an increase in pulmonary extravascular fluid.<sup>9</sup>

Although rare in people exercising on land, pulmonary edema is more routinely reported in individuals participating in swimming or other immersion-related sports.<sup>10</sup> Adir and coworkers describe a series of 70 teen athletes who, over a 3-year period, developed SIPE.<sup>10</sup> All cases occurred in trainees who were swimming semi-reclined in warm



Fig. 1. Results of chest x-ray taken 5 days after the incident.

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seawater and wearing fins. Similarly, Koehle and associates reviewed 60 published cases of immersion-induced pulmonary edema in 56 individuals. Only 9 cases were associated with endurance swimming. The rest were associated with scuba diving and breath-hold diving.<sup>11</sup> Three cases of right-sided pulmonary edema were described in men who swam right side down during US Navy SEAL training manoeuvres.<sup>12</sup>

The mechanism by which cold-water immersion and exercise lead to a pulmonary capillary leak is probably related to a sudden increase in right ventricular preload and increased pulmonary artery pressures.<sup>10-13</sup> Increased preload is due to cold-induced vasoconstriction, which can lead to an increase in the left ventricular afterload; and this, in turn, can contribute to pulmonary edema. Even if a swimmer is wearing a wetsuit, vasoconstriction can occur.<sup>10-13</sup> Excessive volume loading before exercising may also play a role as 8 cases of SIPE were identified in military recruits who drank 5 L of water before exercise.<sup>14</sup>

Interestingly, there have been no reports of SIPE in Olympic swimmers, but there is one case published of a triathlete who developed dyspnea with slight hypoxia and right-sided pulmonary crackles some 8–9 hours after the swim. Results of the chest x-ray in this case were normal.<sup>15</sup>

## Epilogue

The patient was warmed and dried, given supplemental oxygen via face mask, and 20 mg of furosemide was administered intravenously. Her respiratory distress and hemoptysis rapidly resolved. A second troponin measured 24 hours later was normal, as was a transthoracic echocardiogram. Five days later, results of a second chest x-ray were completely normal (Fig. 1, previous page).

**Competing interests:** None declared.

**Key words:** dyspnea; wheeze; hemoptysis; swimming

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