



Case Report

Acute eosinophilic pneumonia caused by an exploding mobile battery: A case report

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ABSTRACT

A 42-year-old woman presented to our hospital with fever and worsening dyspnea. Eight days prior to symptom onset, she inhaled smoke from a fire caused by an exploded mobile battery. Infiltrative shadows were observed in the bilateral lung fields on chest computed tomography scan, and the eosinophil fraction of the bronchoalveolar lavage fluid was elevated to 61.2 %. Therefore, she was diagnosed with acute eosinophilic pneumonia (AEP). Although AEP can be triggered by various inhalants, including tobacco exposure, this is the first reported case of AEP caused by a mobile battery explosion.

1. Introduction

Acute eosinophilic pneumonia (AEP) is rare disease, febrile illness characterized by acute respiratory failure, diffuse radiographic infiltrates and pulmonary eosinophilia, without other eosinophilic lung diseases [1]. The condition is caused by inhalation exposure, drug use, or infection. Of the inhalation exposures, tobacco smoking has been the most frequently implicated trigger. Other reported causes of inhalation include cave exploration, fireworks, and smoke from collapsing buildings [1]. To date, reports of fire-induced AEP have been limited [2]. This case report highlights a woman who developed AEP after inhaling smoke from a mobile battery explosion.

2. Case presentation

A 42-year-old woman with type 2 diabetes mellitus and atopic dermatitis, presented to the hospital with a fever in the 38 °C range, joint pain, and dyspnea on exertion. The patient was a cigarette smoker (20 cigarettes/day) who had switched to heated tobacco product (HTP) 8 years ago. The patient had consistently used the same brand and flavor of HTPs for more than a year, with no history of interruption, before her admission. Her diabetes mellitus was managed with empagliflozin and semaglutide. Eleven days before admission, a mobile lithium-ion battery exploded at her home, igniting a sofa and causing a fire (Fig. 1). Although she immediately extinguished the fire with water and airing the room, it remained filled with smoke for approximately 10 min. Eight days later, she developed a fever around 38 °C and joint pain, followed by worsening dyspnea on exertion. Despite receiving an oral antibacterial drug, her dyspnea worsened, leading to our hospital admission with an oxygen saturation of 84 % on ambient air.

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Auscultation revealed fine crackles in the bilateral upper and left lower lung fields. Other physical examination findings were normal. Laboratory findings showed a white blood cell count of 9290 cells/ μL with eosinophils at 994 cells/ μL , and immunoglobulin E levels of 2666 IU/mL. Chest radiography revealed bilateral infiltration, and chest computed tomography showed diffuse ground-glass opacity (Fig. 2). Bronchoalveolar lavage fluid (BALF) was collected on the day after admission. The BALF recovery rate was 64 % (96/150 mL), with a cell count of 48.75×10^4 cells/mL including 61.2 % eosinophils. The BALF culture revealed negative results. Based on diagnostic criteria, she was diagnosed with AEP [3]. After steroid therapy initiation, her clinical symptoms, laboratory findings, and chest radiographic findings improved quickly. She was discharged on the fifth day of hospitalization. The steroid therapy was tapered off and discontinued after 2 months. She resumed smoking during her illness; however, her symptoms did not relapse.

3. Discussion

This is a rare case of AEP caused by smoke exposure from a mobile battery explosion. The diagnosis of AEP was based on following criteria: 1. acute onset of febrile respiratory symptoms, 2. bilateral diffuse infiltrates on chest radiographs, 3. hypoxemia, 4. pulmonary eosinophilia, 5. no exposure to drugs known to cause pulmonary eosinophilia, and 6. absence of infection or other known causes of eosinophilic lung disease [3]. The patient's rapid improvement with steroid therapy further supported the diagnosis. Generally, AEP is associated with tobacco smoking [1], and increased smoking, resumption, brand changes, or passive smoking exposure, have been reported as potential triggers of AEP [4]. Recently, AEP cases caused by HTPs or e-cigarettes have been reported as the number of users increases [5]. In this case, she was a current HTP smoker, however, she had been consistently using the same HTP brand and flavor for over a year, without any recent changes in smoking habits or exposure. Additionally, she resumed smoking HTPs after discharge, yet did not experience any recurrence of symptoms. Therefore, cigarette smoking or HTP were not considered the cause of her presenting complaints. Based on the timing of exposure and the onset of the disease, the mobile battery explosion was considered the cause of AEP.

Smoke sources such as fireworks, cave exploration, or building demolition, have previously been associated with AEP [1,6]. Although a case of fire-related AEP have been reported [2], the relationship between the timing of smoke exposure and the onset of AEP was not described, leaving the causal relationship remains unclear. In our case, the timing, cause of the fire, and disease course were clear, supporting the diagnosis of fire-related AEP. Therefore, this report highlights the first demonstrated case establishing a relationship between AEP and fire exposure.

Lithium-ion batteries (LIBs) are widely used [7]. Accidents related to fires and explosions occur frequently all over the world [7], and burns and traumatic injuries are commonly reported [8]. A study analyzing the gases released by LIB explosions discovered that aerosols in the inhalable size range were released in large quantities including metal elements, measuring 5–10 μm [9]. In particular, cathode fragments contain transition metals, such as nickel, manganese, and cobalt [9]. A previous study that investigated the BALF findings of patients with AEP caused by the collapse of the World Trade Center in New York City reported the presence of metal particles [9]. Considering this, the inhalation of metal particles might have induced AEP in our patient.

This case report has several limitations. First, because no inhalation challenge test with smoke from a mobile battery explosion were conducted, the cause was determined based on medical interviews. Second, we did not analyze the particles contained in the BALF and the diagnosis was not confirmed by histology.

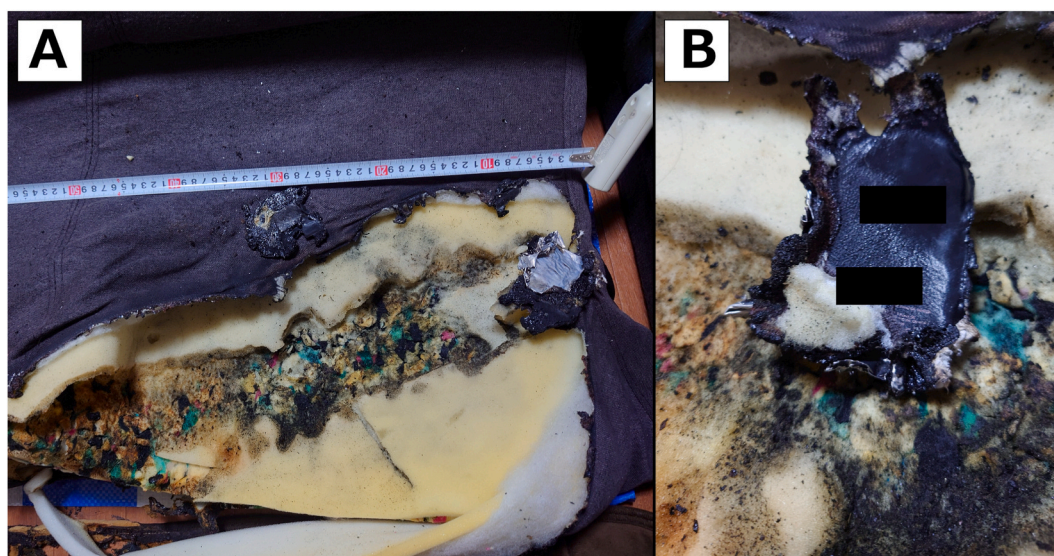


Fig. 1. (A) The scene at the time of the fire due to an explosion of a mobile battery. (B) Exploded and deformed mobile battery.

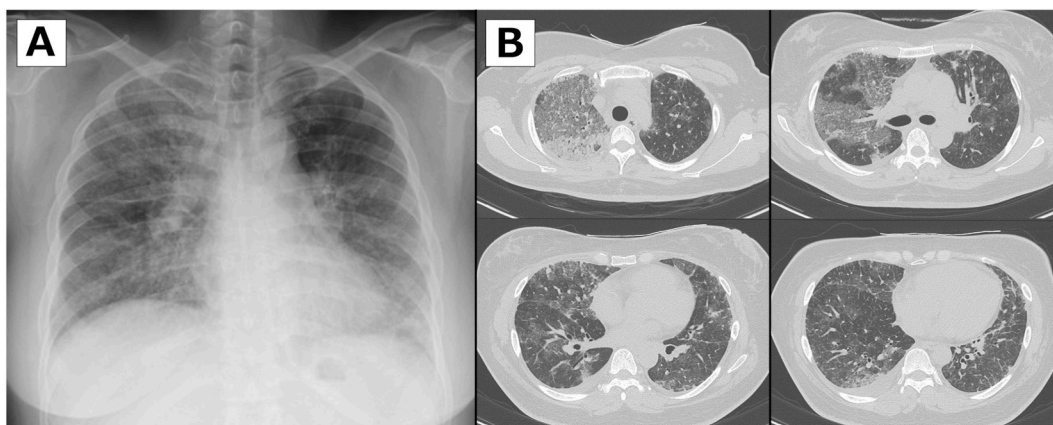


Fig. 2. (A) Bilateral infiltrations were observed on chest radiography. (B) Diffuse ground-glass opacity with interlobular septal thickening and bilateral small pleural effusions were evident on chest computed tomography.

4. Conclusion

We described a patient who developed AEP due to a mobile battery explosion. Aerosols generated by the explosion of LIB may be the underlying cause. This is the first report to describe a case of fire-induced AEP.

CRediT authorship contribution statement

Hiroe Aramaki: Writing – original draft. **Masafumi Shimoda:** Writing – review & editing. **Kozo Morimoto:** Writing – review & editing. **Kozo Yoshimori:** Writing – review & editing. **Ken Ohta:** Writing – review & editing. **Yoshiaki Tanaka:** Writing – review & editing.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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None declared.

Glossary:

| | |
|-------------|------------------------------|
| AEP | acute eosinophilic pneumonia |
| HTP | heated tobacco product |
| BALF | bronchoalveolar lavage fluid |
| LIBs | Lithium-ion batteries |

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