International Journal of Emergency Medicine

CASE REPORT

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# A hidden danger: lung abscess following inhalation of kerosene-based pyrethroid insecticide spray

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## Abstract

**Background** Pyrethroid insecticides are widely used because of their low toxicity in humans. Spray-type pyrethroids are often formulated with kerosene as a carrier solvent, and inhalation of kerosene-containing products can lead to pneumonitis and the formation of lung abscesses. We report a case of chemical pneumonitis resulting in the development of a lung abscess due to the intentional inhalation of pyrethroids.

**Case presentation** A man in his 50s in a psychiatric hospital for transient psychotic disorder attempted suicide during an overnight leave from the hospital. He drank sodium hypochlorite, put a nylon bag over his head, and sprayed pyrethroid insecticide inside the bag. He was found collapsed and was transported to our emergency room. On arrival, his $SpO_2$ was 100% on $O_2$ at 10 L/min by mask (100% on room air at ambulance arrival), his circulation was stable, and his Glasgow Coma Scale score was 10 (E1V3M6), which improved to 15 (E4V5M6) in about one hour. A chest computed tomography (CT) scan showed ground-glass shading in both lungs. We diagnosed him as having pneumonia and started antimicrobial therapy. On day 13 of hospitalization, we found multifocal hypoabsorptive areas, and a diagnosis of lung abscess was made based on CT imaging, and antimicrobial therapy was continued. During the hospitalization, he expectorated bloody sputum. A contrast chest CT scan obtained on day 71 of hospitalization showed a pseudoaneurysm in the abscess cavity, for which we performed successful transcatheter coil embolization. On day 77, the abscess was shrinking, and he was transferred to another hospital for continued treatment. However, he again had bloody sputum and was transferred back to our hospital on day 113. Another contrast chest CT scan revealed the formation of a new aneurysm, and on day 114, we successfully performed coil embolization again, and he was transferred back to the other hospital on day 116.

**Conclusion** Spray-type pyrethroid insecticides contain the organic solvent kerosene. Inhalation of kerosene has been reported in several cases of chemical pneumonitis leading to lung abscess. Clinicians should pay attention to kerosene contained in insecticides and the circumstances under which they are used. Early recognition and aggressive treatment can likely prevent severe outcomes.

**Keywords** Chemical pneumonitis, Lung abscess, Hemoptysis, Pyrethroid insecticides, Kerosene

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## Background

Pyrethroid insecticides are widely used against insects and have less toxicity in humans when used regularly [1–3]. However, under specific circumstances, inhalation of these substances can lead to severe respiratory complications [4–8]. Spray-type pyrethroid insecticides commonly contain kerosene as a solvent. While there have been previous case reports of lung abscesses developing after kerosene inhalation alone [9, 10], there have been no reported cases specifically related to the inhalation of kerosene-containing pyrethroid insecticides. To our knowledge, this is the first detailed case report of a lung abscess caused by the inhalation of a pyrethroid insecticide.

## Case presentation

A man in his 50s with a transient psychotic disorder attempted suicide by ingesting sodium hypochlorite and inhaling pyrethroid insecticide after covering his head with a nylon bag and spraying the insecticide inside. He was found by his family members and transported to our hospital.

On his arrival at our emergency department, his airway was open, and his respiratory rate was 20 breaths/min, with an oxygen saturation of 100% on oxygen at 10 L/min by mask (100% on room air at ambulance arrival). His blood pressure was 103/73 mmHg, and heart rate was 75 beats per minute. His Glasgow Coma Scale score was 10 (E1V3M6), which improved to 15 (E4V5M6) after about one hour, and his pupils were equal and reactive to light at 3 mm bilaterally. His body temperature was 37.0 °C. He appeared in no distress, and no injuries were found on physical examination. On auscultation, breath sounds were clear, and the heartbeat was regular without any murmurs. His abdomen was flat, soft, and nontender.

A complete blood count revealed a white blood cell count (WBC) of 10,590/μL, hemoglobin of 14.5 g/dL, and platelet count of 250,000/μL. Biochemical testing showed a C-reactive protein (CRP) value of 0.06 mg/dL. Arterial blood gas analysis results were pH: 7.393, $PaCO_2$: 39.8 mmHg, $PaO_2$: 164 mmHg ($PaO_2/FiO_2$ ratio 164), and lactate: 12 mg/dL.

A chest X-ray on arrival revealed bilateral diffuse infiltrates, and chest CT revealed not infiltrative shadow but ground-glass opacities in the right middle lobe and bilateral lower lobes, which suggested only chemical pneumonitis (Fig. 1A). He was admitted to the intensive care unit for close monitoring and supportive care. Bronchoscopy was performed, which showed only diffuse mild redness of the bronchial wall. Furthermore, we initially treated him with broad-spectrum antibiotics for pneumonia caused by chemical pneumonitis because polymicrobial pattern were detected in the gram stain of the sputum on day 2. Despite starting antibiotic treatment early, considering the possibility of aspiration pneumonia, his respiratory condition worsened. CT on day 4 showed new signs of atelectasis and pleural effusion in the dorsal side of both lungs, and his pneumonia was worsening (Fig. 1B), and he required high-flow nasal cannula therapy with elevated inflammatory markers (WBC 15,430/μL, CRP 22.02 mg/dL). Follow-up imaging on day 13 confirmed the development of a lung abscess in the right middle lobe and left lower lobe (Fig. 1C). The lung ultrasound showed septa and fibrous components, and Pseudomonas aeruginosa was detected in deep sputum culture via bronchoscopy. The inflammatory response peaked (WBC 31,080/μL, CRP 19.59 mg/dL) with increased HFNC settings.

We regularly adjusted his antibiotic regimen based on sputum culture results. We considered surgical curettage for the lung abscess, but we continued antimicrobial therapy because the inflammation and abscess on CT obtained on day 45 were improving (Fig. 1D), reducing his oxygen requirements and inflammatory markers, achieving room air breathing (WBC 8,080/μL, CRP 4.13 mg/dL). In addition, we continued supportive care including oxygen therapy and nutritional support. Pharmacological thromboprophylaxis was not administered during the hospital course as it was not clinically indicated in this case. On day 71, he maintained stable oxygenation and normalized inflammatory markers through the subsequent course. However, during his recovery, the patient experienced two episodes of hemoptysis caused by pulmonary artery pseudoaneurysms. The first occurred on day 71 in the A5 branch (Fig. 2), and the second on day 113 in the A8 branch (Fig. 3). Both were successfully treated with coil embolization. After each procedure, his condition stabilized, allowing transfer to another hospital for continued antimicrobial therapy.

## Discussion

Pyrethroid insecticides are generally safe for humans when used properly [1–3]. However, aerosol-type pyrethroid insecticide contains organic solvents such as kerosene and can cause significant respiratory disorders when inhaled under specific circumstances [4, 9–11]. In this case, we showed the severe complications that can develop, including lung abscess and pulmonary artery pseudoaneurysm [12].

Similar imaging findings between this case and other cases of kerosene-related pneumonia suggest that high concentrations of pyrethroid insecticides containing kerosene can lead to similar severe outcomes. These cases show the importance of recognizing the potential for severe respiratory complications after exposure to pyrethroid insecticides, especially at high concentrations [9, 10].

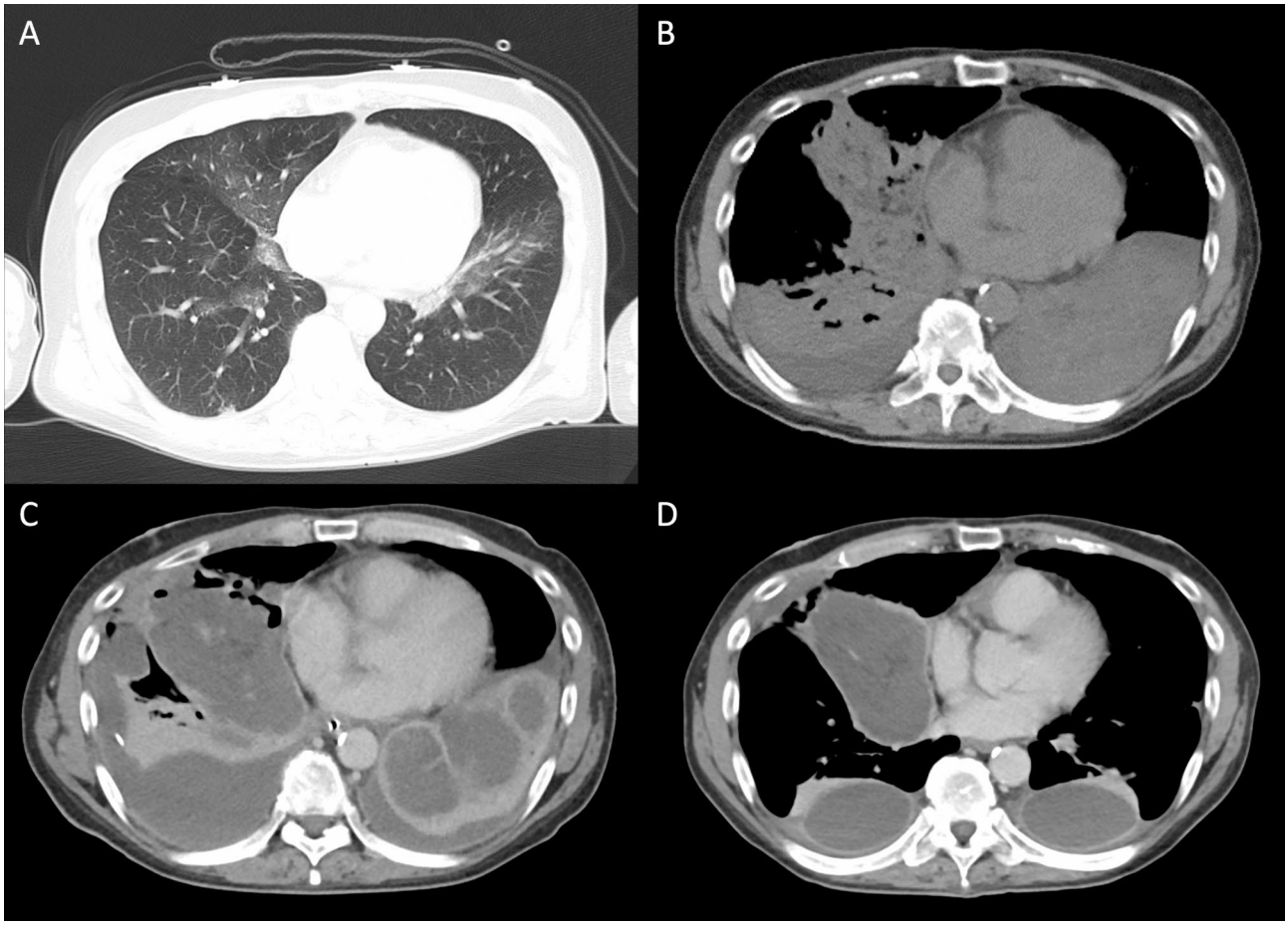


**Fig. 1** CT scans obtained during pneumonitis and evaluation of lung abscess. **A** Ground-glass opacities in the right middle lobe and bilateral lower lobes on hospital arrival, suggesting chemical pneumonitis. **B** Bilateral diffuse atelectasis and pleural effusion in the dorsal side of both lungs on day 4. **C** Multiple lung abscesses detected in the right middle lobe and left lower lobe on day 13. **D** Follow-up CT scan showing improvement of lung abscess on day 45

Pyrethroid insecticides contain irritant properties that can lead to chemical pneumonitis. Although the patient was also exposed to sodium hypochlorite, which can cause respiratory injury [13], the radiological findings were atypical for chlorine exposure, which usually presents only as ground-glass opacities. Furthermore, early broad-spectrum antibiotic administration considering aspiration pneumonia, the patient developed lung abscesses, suggesting that the possibility of aspiration pneumonia leading to lung abscess is low. The development of lung abscess is more characteristically associated with kerosene exposure, as seen in previous cases of kerosene-induced lung injury [9, 10]. While the combination might have contributed to initial inflammation, the progression to abscess formation is most consistent with the known effects of kerosene inhalation. Initial inflammation can progress to secondary bacterial infection and significant abscess if initial treatment is delayed or inadequate. The treatment for chemical pneumonitis is basically just oxygen therapy, but in this case, we started antibacterial treatment early, considering aspiration pneumonia from the result of the gram stain [14, 15]. Despite early broad-spectrum antimicrobial therapy based on gram stain, the present patient developed lung abscesses, which indicates the severity of the inflammation caused by irritants in pyrethroid insecticides and the possibility that complications such as pulmonary artery pseudoaneurysm can develop. Clinical management of chemical pneumonitis caused by inhalation of pyrethroid insecticides requires early recognition, aggressive treatment, and careful monitoring for lung abscess in cases of high-concentration inhalation.

It is important to customize antibiotics according to culture results for effective antimicrobial therapy against abscesses. Clinicians need to manage the risks associated with pseudoaneurysm development and bleeding and prevent serious complications such as massive bleeding. This might require interventional radiology procedures such as coil embolization to treat pseudoaneurysms [16].

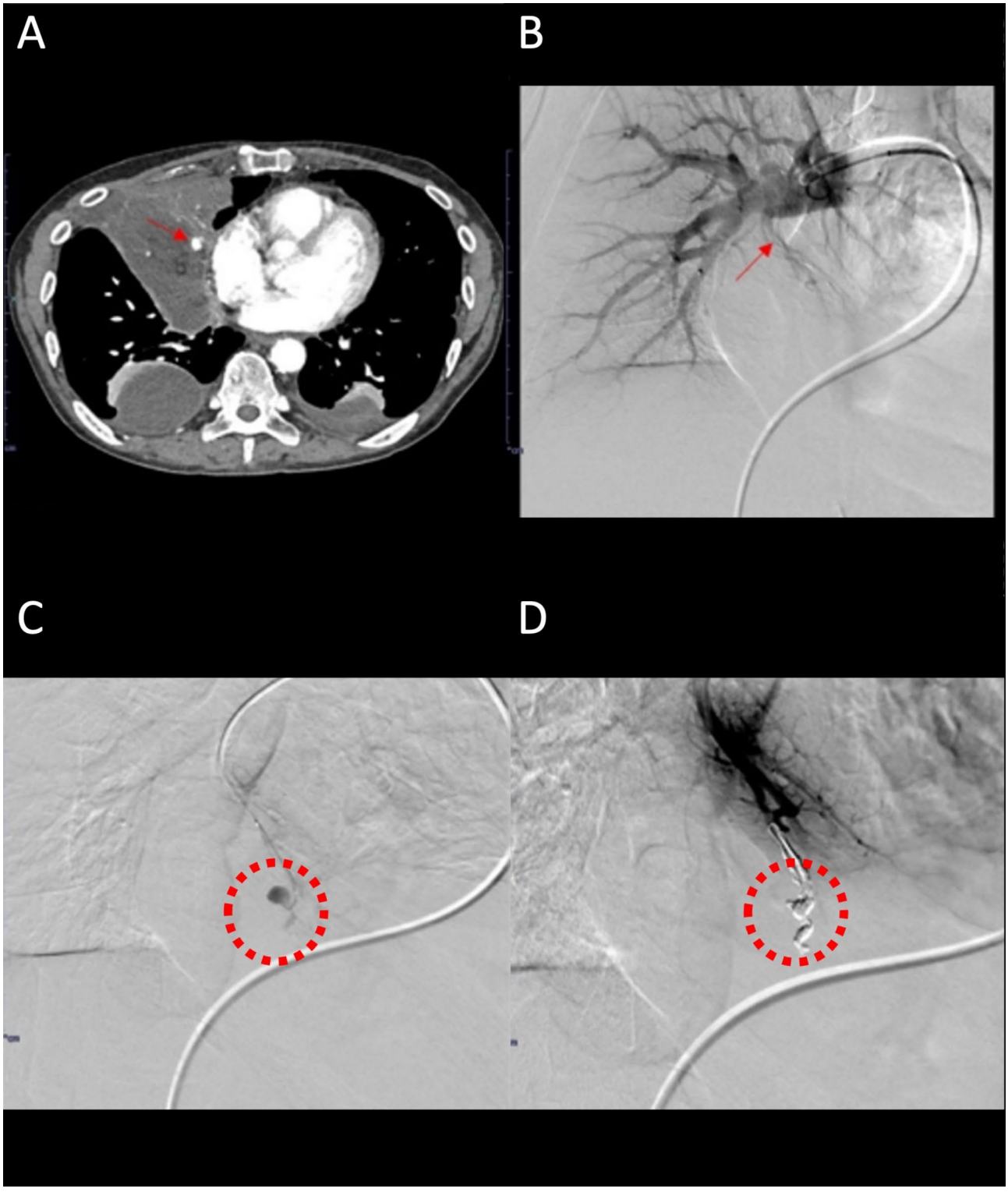


**Fig. 2** CT scan showing the first pulmonary artery pseudoaneurysm and fluoroscopic images of coil embolization. **A** Contrast-enhanced CT obtained to detect pseudoaneurysm in A5 branch (red arrow). **B** Angiography to identify the responsible vessel (red arrow). **C** Aneurysm delineated by red dashed circle. **D** Coil embolization of the pseudoaneurysm (red dashed circle)

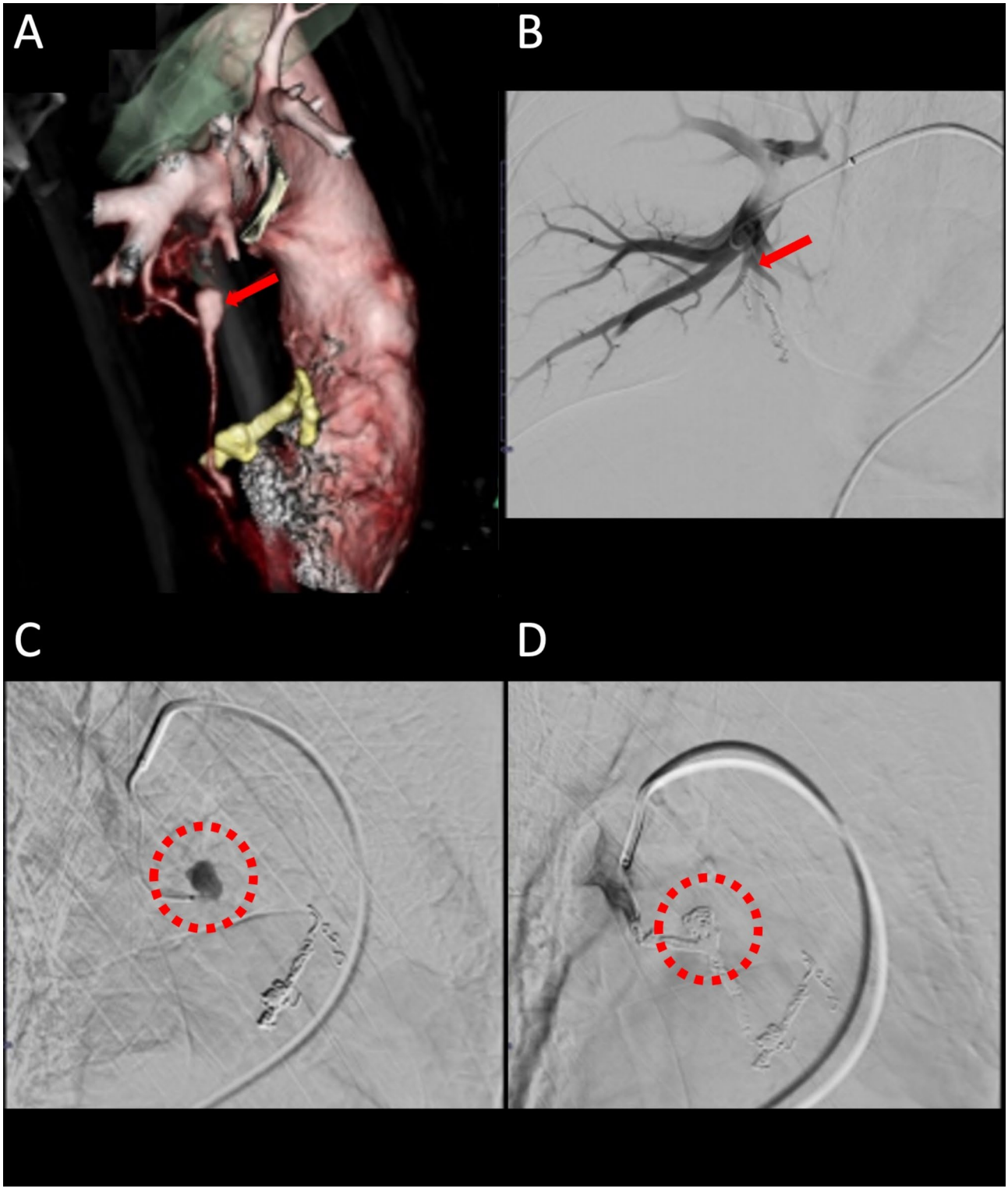


**Fig. 3** CT detection of a second pulmonary artery pseudoaneurysm and fluoroscopic images of coil embolization. **A** Three-dimensional CT to detect pseudoaneurysm in A8 branch (red arrow). **B** Angiography to identify the responsible vessel (red arrow). **C** Pseudoaneurysm delineated by red dashed circle. **D** Coil embolization of the pseudoaneurysm (red dashed circle)

## Conclusion

This case shows several severe respiratory complications that likely developed due to the inhalation of a pyrethroid insecticide, which contains organic solvents such as kerosene. Clinicians should pay attention to kerosene-containing insecticides and the circumstances under which they are used. Even if it is thought that it is only chemical pneumonitis or secondary bacterial pneumonia, it is necessary to actively perform culture and CT, assuming that it will become serious, leading to lung abscesses and subsequent pseudoaneurysms. Early recognition of patients with a similar exposure history can likely prevent severe outcomes.

### Abbreviations

| | |
|---|---|
| CRP | C-reactive protein |
| CT | Computed tomography |
| $FiO_2$ | Fraction of inspired oxygen |
| HFNC | High-flow nasal cannula |
| $PaCO_2$ | Partial pressure of carbon dioxide |
| $PaO_2$ | Partial pressure of oxygen |
| WBC | White blood cell |

### Acknowledgements

Not applicable.

### Author contributions

K.O. and T.H. drafted the main manuscript. K.O. and Y.Y. prepared the figures. H.K., R.T., Y.Y., and J.O. revised the manuscript. All authors reviewed and approved the final version.

### Funding

Not applicable.

### Data availability

No datasets were generated or analysed during the current study.

## Declarations

### Ethics approval and consent to participate

Ethics approval was not required, and informed consent to participate was obtained from the patient.

### Consent for publication

Informed consent for publication was obtained from the patient.

### Competing interests

The authors declare no competing interests.

Received: 12 November 2024 / Accepted: 4 February 2025
Published online: 11 February 2025

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