

# Late Diagnosis of Methamphetamine Inhalation Related Pneumothorax, Pneumomediastinum and Diffuse Subcutaneous Emphysema: A Case Report

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Pneumothorax, pneumomediastinum and/or subcutaneous emphysema are important differential diagnosis for patients manifesting dyspnea or chest pain in the emergency department (ED). Inhalation of methamphetamine as well as other abuse substances could rarely induce above-noted complications. However, most ED patients are reluctant to reveal the use of illicit substances. Therefore, prompt toxicologic screening is warranted in confirming the diagnosis of substance abuse in the ED. We herein report a 22-year-old male patient who presented to the ED with diffuse subcutaneous emphysema, pneumomediastinum and pneumothorax after methamphetamine inhalation. The diagnosis of methamphetamine abuse was delayed because the patient did not provide the accurate drug exposure history at the outset. With the help of appropriate toxicologic screening, the diagnosis was finally made and early counseling was provided to prevent further drug abuse and the recurrence of pneumothorax/pneumomediastinum.

**Key words:** *methamphetamine, pneumothorax, pneumomediastinum, subcutaneous emphysema*

## Introduction

Methamphetamine is a powerful central nervous system stimulant, widely abused by adolescents and young adults around the world.<sup>1</sup> The common toxic effects of methamphetamine include hypertension, hallucinations, psychosis, violent behavior, hyperthermia, and convulsions.<sup>2</sup> Severe methamphetamine poisoning can even lead to multiple organ failure and death.

Pneumomediastinum, subcutaneous emphysema and pneumothorax after methamphetamine inhalation were rarely reported;<sup>3</sup> however, it could be potentially life-threatening. Moreover, in the absence of a clear exposure history, it is difficult to promptly diagnose

methamphetamine inhalation-related pneumothorax in the emergency department (ED).

Here, we report a male case who presented to the ED with diffuse subcutaneous emphysema, pneumomediastinum, and pneumothorax after methamphetamine inhalation. The diagnosis was delayed because the patient did not provide an accurate drug exposure history at the outset.

## Case Report

A 22-year-old homosexual male college student was diagnosed with human immunodeficiency virus (HIV) infection and syphilis two months ago. He was under antiviral treatment for HIV. On arrival at the

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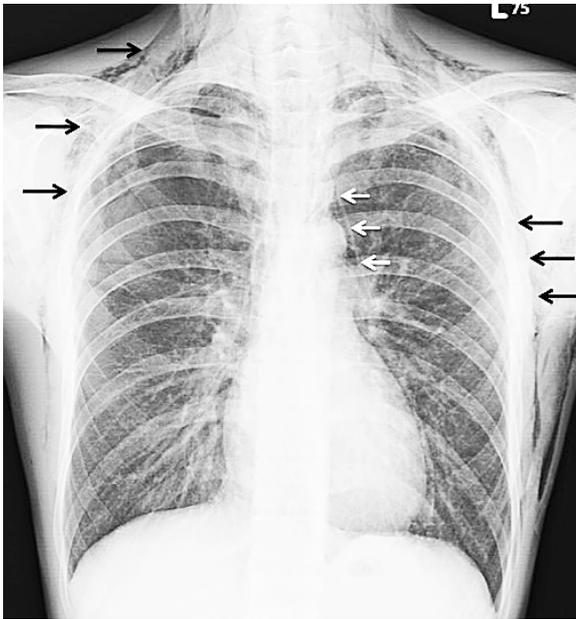
ED, he stated that he ran a marathon two days ago. After the marathon, he experienced chest pain with shortness of breath, which was aggravated by coughing and deep breathing. He denied having any other significant history, such as chest trauma.

His vital signs were as follows: blood pressure 134/85 mmHg, pulse 128/min, respiratory rate 20/min, and body temperature 35.8 °C. Physical examination was remarkable for decreased breath sound over his right lung and crepitus in the lower part of the neck. His laboratory data were remarkable only for mild hypokalemia with serum potassium level of 3.0 mmol/L and slightly elevated creatinine phosphokinase level of 229 U/L. Electrocardiography (ECG) revealed normal sinus rhythm without any evidence of myocardial ischemia. Chest X-ray (CXR) showed pneumomediastinum and subcutaneous emphysema (Fig. 1), and chest computed tomography (CT) scan revealed right pneumothorax, pneumomediastinum, and diffuse subcutaneous emphysema over bilateral chest wall and lower part of the neck (Fig. 2).

With acceptable oxygen saturation and respiratory pattern, only conservative treatment with supplementary oxygen was given. Because the patient's laboratory data were inconsistent with history of recent marathon running and he was diagnosed with sexually

transmitted diseases, we arranged urine toxicologic screen for him. On day 3, the results of toxicologic screening confirmed the presence of methamphetamine in his urine. Therefore, we carefully re-evaluated the patient's exposure history, and he finally admitted that he had not run a marathon. Instead, he developed chest pain and shortness of breath after inhaling methamphetamine two days ago. He also stated that he has been abusing methamphetamine for two months because he suffered from depression due to his HIV diagnosis. He denied ever abusing other substances.

The patient's condition gradually improved after admission. On day 3, he presented with normal respiratory pattern under room-air breathing. Follow-up CXR showed much improvement of his pneumothorax and pneumomediastinum. He was then discharged, and we educated him about the potential hazards of substance abuse. No more pneumothorax or subcutaneous emphysema was noted at the follow-up CXR at the outpatient clinic one month later.



**Fig. 1.** Chest X-ray (CXR): pneumomediastinum (white arrows) and subcutaneous emphysema (black arrows).



**Fig. 2.** Computed tomography (CT): right pneumothorax (black triangles), pneumomediastinum (white arrows) and diffuse subcutaneous emphysema (black arrows).

## Discussion

Spontaneous pneumothorax or pneumomediastinum is uncommon in adolescents and young adults. Often, it occurs after barotrauma caused by severe asthma, cough, vomiting, or exercise, which causes small alveoli air leaks.<sup>4</sup>

Toxic substances that have been linked to spontaneous pneumothorax after inhalation include tobacco, marijuana, heroin, cocaine, ecstasy, methamphetamine, and cannabinoids.<sup>3,5-8</sup> It is generally believed that users taking these substances would adopt a Valsalva maneuver (a deep inspiration with prolonged breath-holding) in order to increase the uptake of the inhaled substance. Violent cough may also be induced by inhaled substance related airway stimulation. Both mechanisms could increase intra-alveolar pressure and hence cause small alveoli rupture and air leaks.<sup>8</sup> In this case report, the development of spontaneous pneumothorax in the patient may also be attributable to similar etiologies.

Additional mechanism explaining the development of pneumothorax after substance inhalation has been proposed for alkaline cocaine. Alkaline cocaine and other concomitantly inhaled chemicals (e.g., methanol, benzoic acid, or sulfuric acid) may make alveolar wall more fragile by inducing inflammatory response.<sup>5</sup> Such a mechanism may also explain why the onset of pneumothorax symptoms after cocaine inhalation are sometimes delayed. It's unclear whether this mechanism also applies to methamphetamine inhalation related pneumothorax. Nevertheless, the onset of pneumothorax in our case as well as a previously reported case<sup>8</sup> was delayed, which may suggest the possible involvement of alveolar wall inflammation in the development of pneumothorax after methamphetamine inhalation.<sup>8</sup>

Long-term use of methamphetamine can lead to cardiotoxicity, and the relationship between methamphetamine abuse, cardiomyopathy in young adults, and coronary vasospasm has been reported.<sup>9-12</sup> Patients with methamphetamine-related cardiotoxicity may present with cardiogenic chest pain or heart failure upon ED visits, and the clinical manifestations may be confused with pneumothorax. Therefore, careful differential diagnosis should be made, which could be difficult in the absence of a definite substance abuse history.

ED physicians generally would pay attention to the possibility of pneumothorax, pneumomediastinum,

and cardiomyopathy when adolescents and young adults present to the ED with acute chest pain. Detailed history-taking, physical examination, and baseline studies for chest pain, such as CXR and ECG, are thus warranted to make relevant diagnoses promptly. Traditionally, pneumothorax and pneumomediastinum are diagnosed by CXR in the ED. However, recent case reports indicate that CXR may occasionally lead to misdiagnosis. Therefore, if pneumothorax is suspected, chest CT scan is recommended.<sup>3</sup>

When pneumothorax, pneumomediastinum, and/or subcutaneous emphysema are diagnosed, the ED physicians usually focus on the emergent management rather than identifying the true cause of pneumothorax/pneumomediastinum. The possibility of substance abuse related pneumothorax and pneumomediastinum therefore may be overlooked. ED physicians are advised to carefully inquire young adults and adolescents who present to the ED with pneumothorax and/or pneumomediastinum about the possibility of substance inhalation. Often, the patients are reluctant to reveal their illicit substance use. Therefore, an appropriate urine toxicologic screen should be arranged to confirm the diagnosis of relevant substance abuse. Once methamphetamine abuse is diagnosed, early counseling can be provided to prevent further drug abuse and its associated medical and social costs.

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