delay in the diagnosis of brain abscess. All four cases occurred before 1974, and none of the patients received CT scans. The two surviving patients in the antibiotic-only group were evaluated with CT scans at the time of presentation and serially, as was our patient. The contribution of computed tomography to the successful treatment of bacterial brain abscesses was noted in a retrospective analysis of patients treated at the University of California, San Francisco, from 1970 through 1977.[17] The mortality rate before 1974, when computed tomography became available at that hospital, was 44% (8 of 18). In contrast, there were no deaths in the 20 patients diagnosed after the CT scan became available.

In summary, a review of reported cases of listerial brain abscess suggests that, like other forms of bacterial brain abscess, the chance of cure is increased by abscess drainage. Because our patient underwent only needle aspiration of her abscesses and received only four doses of gentamicin, which is known to have poor central nervous system penetration, we think this case shows that a cure of listerial brain abscess is possible without surgical abscess drainage or the use of a nephrotoxic antibiotic even in a patient receiving immunosuppressive medication.

#### REFERENCES


1. Nieman RE, Lorber B: Listeriosis in adults: A changing pattern—Report of eight cases and review of the literature, 1968-1978. Rev Infect Dis 1980; 2:207-227

2. Louria DB, Henle T, Armstrong D, et al: Listeriosis complicating malignant disease—A new association. Ann Intern Med 1967; 67:260-281

3. Dee RD, Lorber B: Brain abscess due to *Listeria monocytogenes:* Case report and literature review. Rev Infect Dis 1986; 8:968-977

4. Spilkin ES, Rachmaninoff N, Climie ARW: *Listeria monocytogenes* meningitis: Report of two cases and review of the literature. Am J Clin Pathol 1968; 49:671-676

5. Buchner LH, Schneierson SS: Clinical and laboratory aspects of *Listeria monocytogenes* infections, with a report of ten cases. Am J Med 1968; 45:904-921

6. Listeriosis. Br Med J 1971; 2:477-478

7. Halkin H, Shacked IJ, Altmann G: Brain abscess due to *Listeria monocytogenes* in a patient with cirrhosis of the liver. Isr J Med Sci 1971; 7:1192-1195

8. Crocker EF, Leicester J: Cerebral abscess due to *Listeria monocytogenes.* Med J Aust 1976; 1:90-96

9. Larsson S, Cronberg S, Winblad S: Clinical aspects on 64 cases of juvenile and adult listeriosis in Sweden. Acta Med Scand 1978; 204:503-508

10. Lectenberg R, Sierra MF, Pringle GF, et al: *Listeria monocytogenes:* Brain abscess or meningoencephalitis? Neurology (Minneap) 1979; 29:86-90

11. Dykes A, Baraff LJ, Herzog P: Listeria brain abscess in an immunosuppressed child. J Pediatr 1979; 94:72-74

12. Larsson S, Linell F: Correlations between clinical and postmortem findings in listeriosis. Scand J Infect Dis 1979; 11:55-58

13. Stam J, Wolters ECH, Van Manen J, et al: *Listeria monocytogenes* abscess in the basal ganglia (Letter). J Neurol Neurosurg Psychiatry 1982; 45:757-758

14. Hutchinson RJ, Heyn RM: Listerial brain abscess in a patient with leukemia: Successful nonsurgical management. Clin Pediatr (Phila) 1983; 22:312

15. Pollock SS, Pollock TM, Harrison MJG: Infection of the central nervous system by *Listeria monocytogenes:* A review of 54 adult and juvenile cases. Q J Med 1984; 53:331-340

16. Spitzer PG, Hammer SM, Karchmer AW: Treatment of *Listeria monocytogenes* infection with trimethoprim-sulfamethoxazole. Rev Infect Dis 1986; 8:427-430

17. Rosenblum MC, Hoff JT, Norman D, et al: Decreased mortality from brain abscesses since advent of computerized tomography. J Neurosurg 1978; 49:658-668


# Association of Spontaneous Pneumomediastinum With Substance Abuse


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THE SPONTANEOUS OCCURRENCE of air in the mediastinum is well described.[1,2] Usually a benign condition, it can be indistinguishable clinically from potentially life-threatening causes of pneumomediastinum such as esophageal perforation.[3] Isolated cases of pneumomediastinum have been reported following the inhalation of marijuana[4,5] and cocaine use.[5-7] We present four cases of adolescents who had pneumomediastinum after inhaling marijuana or alkaloidal cocaine. In all four, recovery was uneventful.

## Report of Cases

### *Case 1*

The patient, a 17-year-old previously healthy male adolescent, was admitted to hospital from the emergency department because he had had acute retrosternal chest pain for six hours that radiated to the neck. There was no history of reactive airways disease, recent trauma, dyspnea, hemoptysis, or tobacco abuse.

On physical examination, the patient was in pain and anxious but in no respiratory distress. Breath sounds and the findings of a cardiac examination were normal. No Hamman's sign was present. Laboratory data revealed normal arterial blood gas measurements while the patient was breathing room air (pH 7.42, $Po_2$ 96 mm of mercury, $Pco_2$ 35 mm of mercury). A posteroanterior chest radiograph was relatively unremarkable, but the lateral view showed lucency

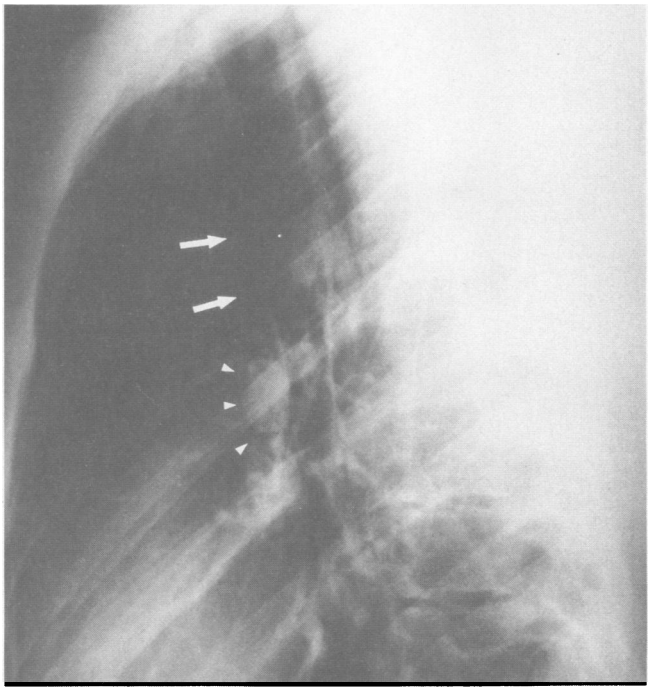

**Figure 1.—A lateral chest radiograph shows pneumomediastinum with air lucency in the pretracheal space (arrows) and surrounding the right pulmonary artery (arrowheads).**

(Fajardo LL: Association of spontaneous pneumomediastinum with substance abuse. West J Med 1990 Mar; 152:301-304)


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anterior and posterior to the trachea and circumferentially around the left pulmonary artery (Figure 1).

On further questioning, the patient admitted to several hours of inhaling alkaloidal cocaine before the chest pain began. Clinical symptoms spontaneously regressed over the next two days, and the patient was discharged after 48 hours of observation. A second chest radiograph taken before discharge showed a decrease in the amount of mediastinal air, and a chest film was normal three days after discharge.

*Case 2*

The patient, a 20-year-old man, presented with shortness of breath and burning substernal chest pain that radiated through his back and up into both sides of his neck. The symptoms occurred about an hour after the patient "free-based" cocaine. In addition, he reported a blow to the midsternal area of the chest on the evening before admission while play boxing. The patient had had pulmonary coccidioidomycosis at the age of 10.

On physical examination there was a pericardial friction rub at the third and fourth intercostal spaces in the midclavicular line and tenderness to palpation over the midsternum and along the right and left paratracheal areas. A chest radiograph showed pneumomediastinum with dissection of air into the subcutaneous tissues of the neck (Figure 2). A laboratory workup elicited no abnormalities.

The patient was observed overnight in the hospital. The findings of a chest film taken 14 hours after admission were unchanged, but his symptoms were resolving. He was discharged from the hospital and followed up in the outpatient clinic. Four days after discharge the patient was asymptomatic and his chest radiograph was normal.

*Case 3*

A 19-year-old man awoke with a sore throat and substernal aching that worsened with inspiration. On physical examination there was a positive Hamman's sign. Chest radiography showed a subtle pneumomediastinum and dissection of free air superiorly into the soft tissues of the neck (Figure 3). A barium esophagogram was normal. The patient later revealed that he had smoked marijuana the evening before his symptoms occurred. The patient's chest radiograph findings were unchanged 24 hours after admission, but his symptoms had resolved and he was discharged. He did not keep his follow-up outpatient appointment.

*Case 4*

The patient, a 16-year-old male adolescent, was transferred from an emergency department in Mexico with pneumomediastinum and chest pain. The patient was well until

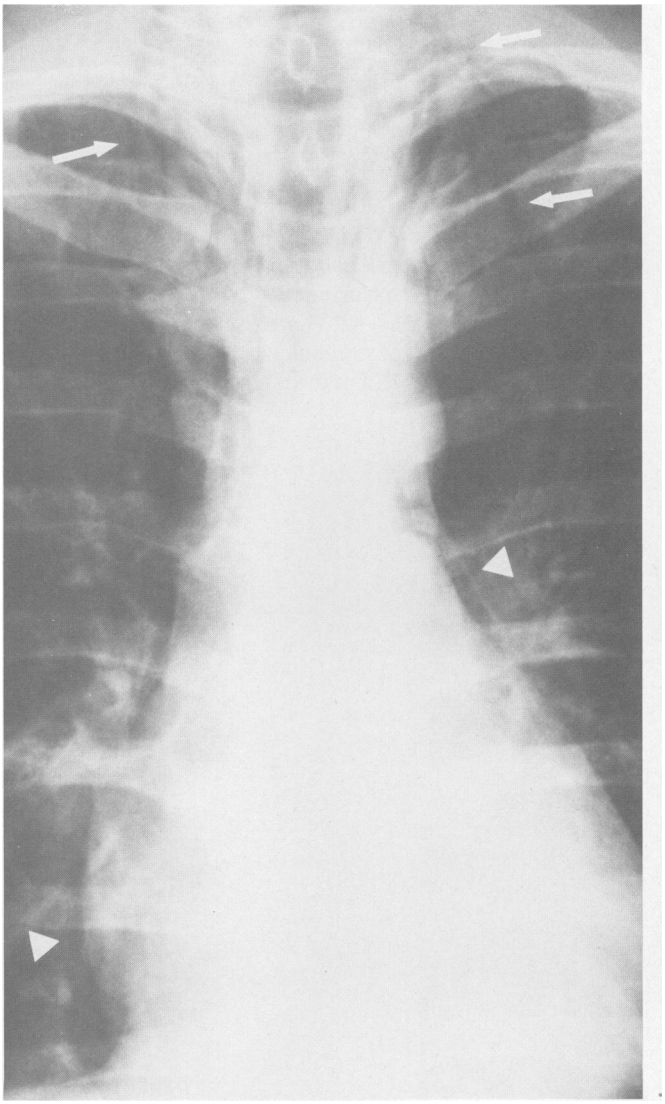

**Figure 2.**—An anteroposterior chest radiograph shows pneumomediastinum **(arrowheads)** with dissection of air into the subcutaneous tissue planes of the neck **(arrows).**

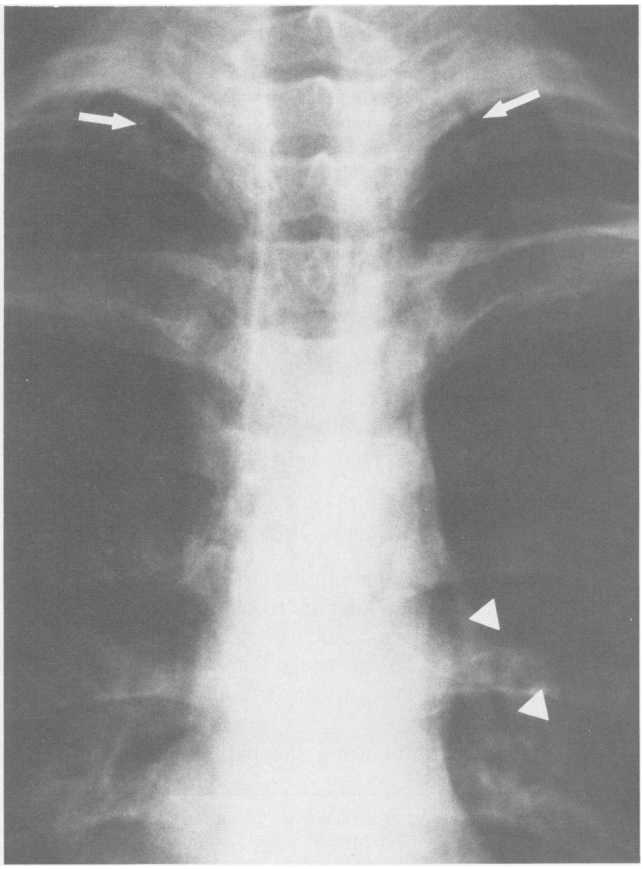

**Figure 3.**—An anterolateral chest radiograph shows pneumomediastinum **(arrowheads)** and dissection of air into the subcutaneous tissues of the neck **(arrows).**

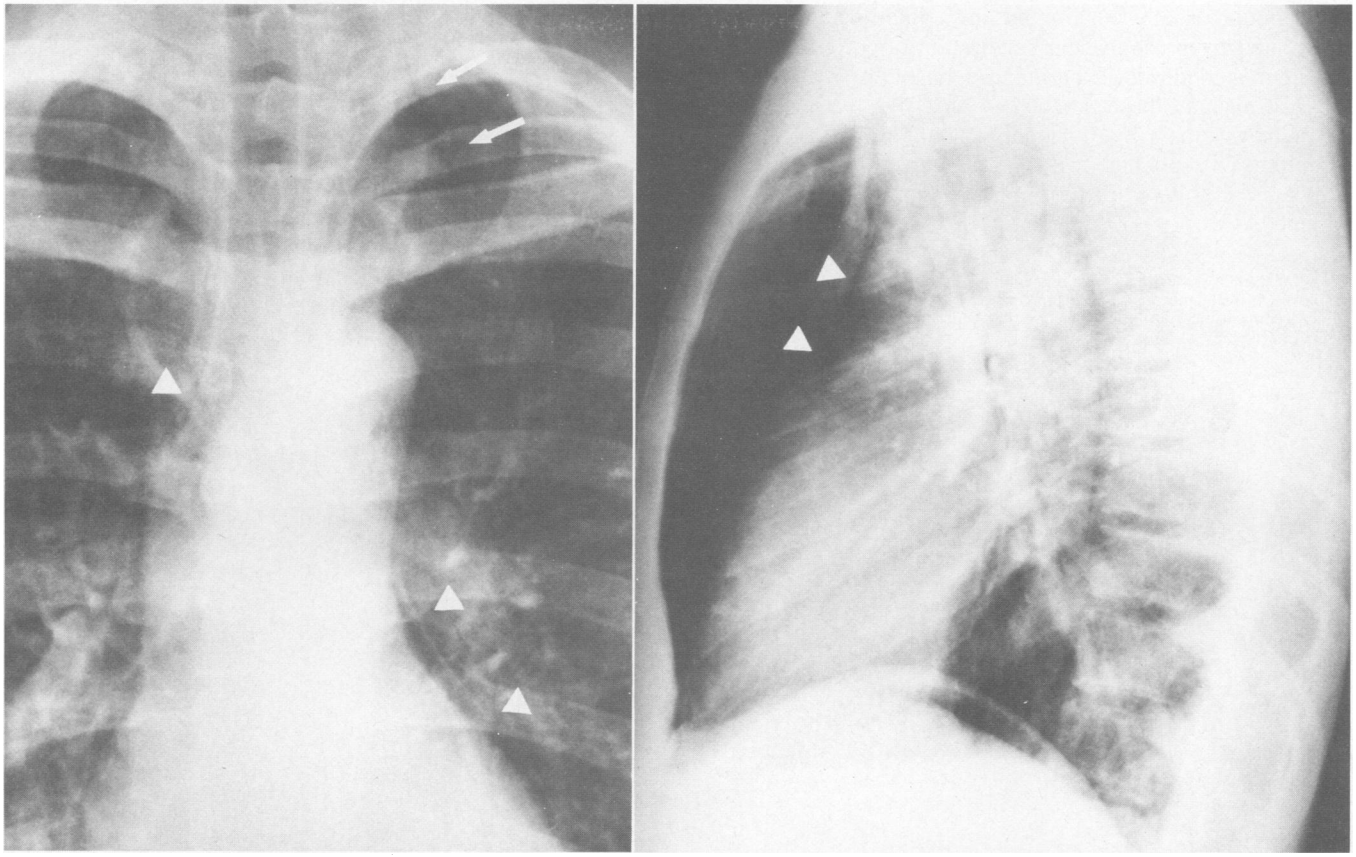

**Figure 4.—Left,** anteroposterior and, **Right,** lateral chest radiographs show subtle pneumomediastinum **(arrowheads)** and subcutaneous emphysema in the neck **(arrows).**

the night before his admission when he reports that he drank six beers and smoked alkaloidal cocaine. His chest radiograph showed pneumomediastinum and subcutaneous emphysema in the neck (Figure 4). The rest of his medical workup elicited no abnormalities. After eight hours of observation in the emergency department, the patient's chest pain resolved and his pneumomediastinum had decreased in size. He was discharged to be followed up by his physician in Mexico.

## Discussion

Pneumomediastinum is classified as nontraumatic (primary or spontaneous) and traumatic (secondary). Spontaneous pneumomediastinum can be seen in adolescents following acute intermittent respiratory obstruction and may be associated with asthma, pertussis, pneumonia, emesis, retching, defecation, straining, weight lifting, or coughing. One report noted that half of all cases of nontraumatic pneumomediastinum were associated with parturition.[8] More recently we have become aware of an association between smoking (freebasing) alkaloidal cocaine ("crack") with the development of pneumomediastinum, probably related to a prolonged Valsalva's maneuver or to the use of positive pressure. Positive pressure is usually applied by a partner, either by direct mouth-to-mouth contact or through blowing into a cylinder.

Alkaloidal or free-based cocaine is created by combining cocaine with a basic solution such as ammonium and a solvent such as ether to create cocaine crystals, which are more volatile than cocaine salt.

The mechanism of primary pneumomediastinum is thought to be related to increased intra-alveolar pressure with the development of a pressure gradient between alveoli and surrounding blood vessels. The pressure gradient causes acute rupture of an overly distended alveolus, alveolar web, or bleb.[1,2] This may involve a negative-pressure gradient during a forced inspiration or a positive-pressure gradient during a prolonged breath-holding (Valsalva) maneuver. In addition, alkaline cocaine and other contaminants (benzoic acid, methanol, or sulfuric acid) on the alveolar wall may cause an inflammatory response and weakening of the adventitia, which may also lead to rupture. This latter mechanism may explain why the onset of symptoms is often delayed. After alveolar rupture, fine bubbles of air track along the vessels and bronchi, coalescing into larger air collections in the mediastinum. The free air may then decompress along the fascial planes of the trachea and esophagus and into the anterior mediastinum and subcutaneous soft tissues of the chest, neck, and axillary regions.

Clinical manifestations of pneumomediastinum include stabbing chest pain, pleuritic chest pain, dyspnea, the so-called mediastinal crunch (Hamman's sign), and subcutaneous emphysema. On a posteroanterior chest radiograph, lucency may be seen along the left heart border, indicating displacement of mediastinal pleura. Lucency indicative of subcutaneous emphysema within the soft tissues of the chest, the axillary region, and the neck may also be seen. On the lateral chest radiograph, air lucency may be seen outlining the hilar pulmonary vessels and extending along the fascial planes of the esophagus and trachea.

Although usually self-limited, this condition must be differentiated from esophageal perforation, a potentially life-threatening condition. A barium esophagogram may be necessary to evaluate these patients.

In the vast majority of patients, pneumomediastinum and symptoms will spontaneously resolve. Close outpatient medical care and follow-up chest films are appropriate for these patients.

**REFERENCES**

1. Macklin MT, Macklin CC: Malignant interstitial emphysema of the lungs and mediastinum as an important complication in many respiratory conditions: Interpretation of clinical picture in light of laboratory experiment. Medicine (Baltimore) 1944; 23:281-358

2. Bodey GP: Medical mediastinal emphysema. Ann Intern Med 1961; 54:46-56

3. Granich MS, Klotz RE, Partlow RC, et al: Spontaneous retropharyngeal and cervical subcutaneous emphysema in adults. Arch Otolaryngol 1983; 109:701-704

4. Miller WE, Spiekerman RE, Hepper NG: Pneumomediastinum resulting from performing Valsalva maneuvers during marijuana smoking. Chest 1972; 62:233-234

5. Luque MA, Cavallaro DL, Torres M, et al: Pneumomediastinum, pneumothorax, and subcutaneous emphysema after alternate cocaine inhalation and marijuana smoking. Pediatr Emerg Care 1987; 3:107-109

6. Shesser R, Davis C, Edelstein S: Pneumomediastinum and pneumothorax after inhaling alkaloidal cocaine. Ann Emerg Med 1981; 10:213-215

7. Adrouny A, Magnuson P: Pneumopericardium from cocaïne inhalation. N Engl J Med 1985; 313:48-49

8. Munsell W: Pneumomediastinum. JAMA 1967; 202:689-693