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Case report: Tension pneumomediastinum from opioid inhalation

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Abstract

Pneumomediastinum is a rare complication of substance use, likely due to a Valsalva maneuver after drug inhalation. There are no previously documented associations between pneumomediastinum and opioid use. A 30-year-old man with a history of recent heroin and fentanyl inhalation presented to the emergency department in respiratory distress requiring intubation. His course was complicated by pneumomediastinum which subsequently developed tension physiology. He required emergent surgical decompression with a “blowhole incision” to his anterior chest. Although a rare complication of polysubstance use, pneumomediastinum can progress to tension physiology, requiring prompt diagnosis and management.

1. Introduction

Emergency department visits related to substance use disorder are becoming increasingly common [1], and emergency physicians should be prepared for the myriad ways these patients can present. Spontaneous pneumomediastinum (SPM) is a rare complication of substance use, and patients typically present with chest pain, shortness of breath, sore throat, and neck pain [2]. SPM usually has a benign course and self-resolves without intervention. However, rarely, SPM can progress to tension physiology, especially in patients requiring positive pressure ventilation. We present a case of tension pneumomediastinum associated with opioid inhalation and describe the medical and surgical management of such cases.

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Author contributions

RVN drafted the manuscript with assistance from ATH, ER, SC, MHV, PAT, CC, and MFO. All authors reviewed and assisted with revisions of the final manuscript. RVN takes responsibility for the manuscript as a whole.

Conflicts of interest

None.

2. Case report

A 30-year-old incarcerated man with a history of polysubstance abuse presented with shortness of breath. He admitted to smoking fentanyl and heroin a few hours prior to arrival. His symptoms began the morning of presentation, including fatigue, malaise, and nausea. On arrival, the patient was afebrile, with a blood pressure of 105/97 mmHg, heart rate of 120 beats per minute, respiratory rate of 36 per minute, and initial oxygen saturation of 81% on room air, with improvement to 98% on 15 l nonrebreather facemask. He was toxic appearing. Bilateral rhonchi and crepitus along the anterior chest wall were noted on initial lung exam. The rest of his physical exam was unremarkable.

Chest x-ray was notable for pneumomediastinum with no evidence of pneumothorax (Fig. 1). The patient's mental status and respiratory status worsened, requiring emergent intubation. Enhanced computed tomography (CT) scan of the chest confirmed extensive pneumomediastinum (Fig. 2). Thirty minutes later, the patient became more unstable and required vasopressor support, concerning for developing tension physiology. Repeat exam now showed the chest wall crepitus expanded to cover his entire anterior chest wall, neck, and lower face. The cardiothoracic surgery service was consulted for emergent surgical decompression of his pneumomediastinum, and a "blowhole incision" was performed at bedside. A 4-cm incision was made below the right clavicle and the incision depth was carried to the pectoralis major fascia, but did not enter muscle. A vacuum-assisted wound device (Wound vac: 3 M-KCI, San Antonio, TX) was placed within the defect, covered with an occlusive dressing, and suction begun at −125 mmHg (Fig. 3). His crepitus resolved over the next several hours, with x-ray resolution of his pneumomediastinum after 2 days. The patient was discharged on hospital day 21 neurologically intact.

3. Discussion

3.1. Pathophysiology

Pulmonary barotrauma is defined as alveolar damage secondary to positive pressure within the bronchial tree, leading to the accumulation of air in extra-alveolar areas, with the most common clinical manifestations being pneumothorax, pneumomediastinum, and subcutaneous emphysema [3]. In our case, we suspect that glottic closure immediately following deep inspiration from inhaled drug use created high positive pressure within the tracheobronchial tree, leading to alveolar rupture and tracking of air into the mediastinum, a phenomenon called the Macklin effect [4].

Inhalation or insufflation of multiple substances have been identified as risk factors in the development of SPM, including cocaine, marijuana, 3,4-Methyl enedioxy methamphetamine (MDMA), and nitrous oxide [5–8]. Case reports on SPM associated with methamphetamine, ketamine, mephedrone, hookah, and vaping have also been reported [9–12]. To our knowledge there are no previous case reports of heroin or other opioid inhalation or insufflation leading to SPM.

3.2. Medical management

SPM is typically a benign disease requiring only conservative management, including observation, bedrest, analgesics, and cough suppressants [2]. There is insufficient evidence to recommend the routine use of prophylactic antibiotics or administration of 100% oxygen. However, patients with pneumomediastinum receiving mechanical ventilation are at risk for further worsening barotrauma. Ventilator settings should be titrated to minimize respiratory rate, plateau pressure, and peak inspiratory pressures. This can be accomplished by reducing positive end-expiratory pressure (PEEP) and tidal volume (TV). For patients with persistent pneumomediastinum, extracorporeal membrane oxygenation (ECMO) may provide additional support [13,14].

3.3. Surgical management

Severe pneumomediastinum may result in tension physiology similar to cardiac tamponade. The increase in mediastinal pressure compromises venous return to the heart, leading to cardiovascular collapse [15]. This rare complication has no well-established treatment modality, however multiple surgical approaches have been historically described, such as decompressive sternotomy [16] and chest tube placement directly within the mediastinum [17]. Our cardiothoracic surgeons chose a less invasive procedure, utilizing a modified “blowhole incision” with negative pressure wound therapy (NPWT), which was also effective at resolving the patient’s extensive subcutaneous emphysema (Figs. 3 and 4). Although the incision does not directly violate the mediastinum, the connection between the tissue planes and the application of the NPWT is effective in draining the mediastinal air [18].

4. Why should an emergency physician be aware of this?

Patients with polysubstance abuse frequently visit emergency departments and can present with various vague complaints. Emergency physicians should be aware of the association between drug ingestion and thoracic barotrauma, as well as its management. In severe cases requiring intubation, emergency physicians should understand initial ventilator management strategies. They should also be aware that pneumomediastinum can progress to tension physiology, requiring emergent decompression.

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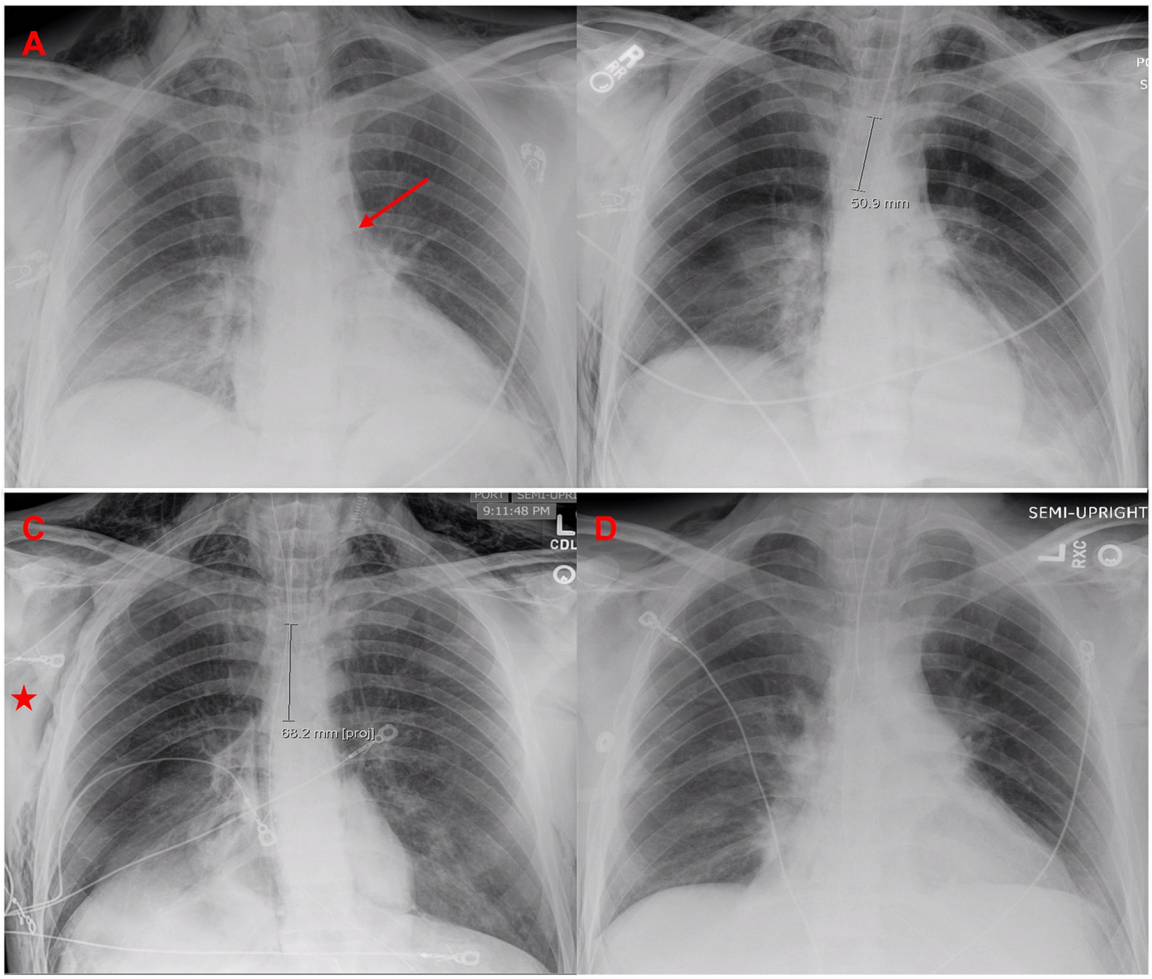

Fig. 1.

Chest x-rays during hospitalization. A. Initial chest x-ray at presentation, demonstrating air within the mediastinum (arrow). B. Chest x-ray post intubation, 3 h after arrival. C. X-ray during tension physiology, demonstrating extensive subcutaneous air (star), 4 h after arrival. D. X-ray following blowhole incision and resolution of pneumomediastinum and subcutaneous air, hospital day 3.

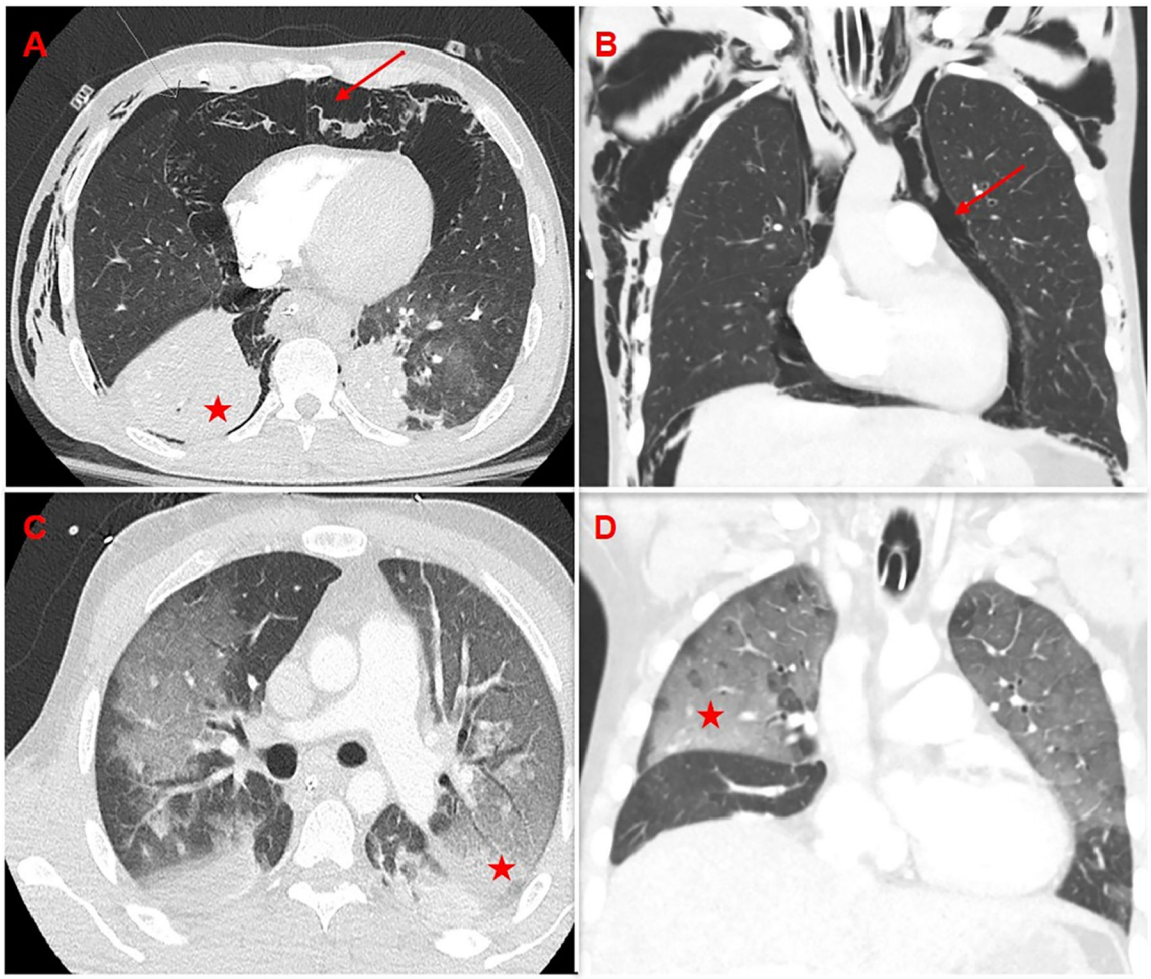

Fig. 2.

Enhanced computed tomography during hospitalization demonstrating pneumomediastinum, extensive subcutaneous emphysema, and eventual resolution. A: coronal section, hospital day 1. B: transverse section, hospital day 1. C: coronal section, hospital day 4, D: transverse section, hospital day 4. Arrows: mediastinal air. Star: lung consolidation, likely from a combination of atelectasis, aspiration and pneumonia.

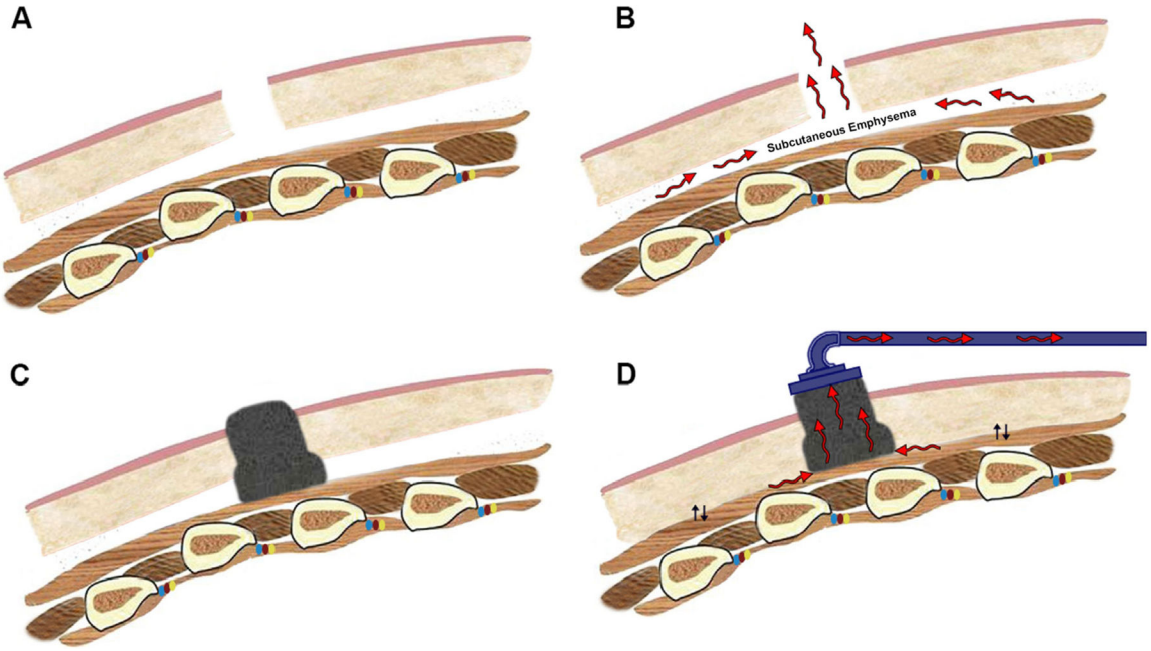

Fig. 3.

Application of negative pressure wound therapy. A: A 4 cm incision is made on the anterior chest below the clavicle. B: Blunt dissection is carried down to maximize egress of the subcutaneous emphysema. C: Black wound vacuum sponge is placed in the wound bed. D: Negative suction pump is connected.

Fig. 4.
Blowhole Incision on Anterior Chest with a Negative Pressure Wound Vacuum. Chest tattoo blurred for patient confidentiality.