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Urgent Care Evaluation and Management of Spontaneous Pneumothorax

Urgent Message: Spontaneous pneumothorax (PTX) occurs unpredictably. Many patients with spontaneous PTX may initially present to urgent care, so it is important for clinicians to include it in the differential diagnosis of patients presenting with acute chest pain and/or dyspnea. Rarely, a spontaneous PTX can progress to a tension PTX if the diagnosis is delayed.

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Editor's Note: *While the images presented here are authentic, the patient case scenario is hypothetical.*

Abstract

A spontaneous pneumothorax (PTX) occurs when an atraumatic pulmonary air leak into the pleural space occurs, resulting in increased intrapleural pressure and variable degrees of lung collapse. The diagnosis of spontaneous PTX relies on clinical assessment and imaging. Point-of-care ultrasound (POCUS) has been shown to be more sensitive than chest x-ray (CXR). Definitive management of spontaneous PTX varies based on the patient's clinical status. Increasingly, stable patients are managed conservatively with serial observation, whereas patients in shock from tension PTX require urgent needle decompression and chest tube placement. It is most important that urgent care (UC) clinicians consider the diagnosis of spontaneous PTX and appropriately refer patients to an appropriate emergency department (ED) when the condition is identified. Recognizing red flags suggesting the need for emergent intervention and activating emergency medical services (EMS) are crucial to prevent adverse outcomes. While UC specific guidelines do not exist, ED referral for all patients with a diagnosis of spontaneous PTX is recommended.

Questions for the Clinician at the Bedside

1. What are the most common risk factors, symptoms, and signs associated with spontaneous pneumothorax (PTX)?
2. What signs and clinical findings are most suggestive of tension PTX?
3. How reliable is chest x-ray for excluding PTX, and how do the test characteristics of x-ray compare with point-of-care ultrasound for the diagnosis of PTX?
4. What options exist for the management of spontaneous PTX, and how are these options affected by the patient's clinical status?
5. Which conditions may clinically or radiographically mimic PTX?

Clinical Scenario

A 32-year-old man with a history of spontaneous PTX

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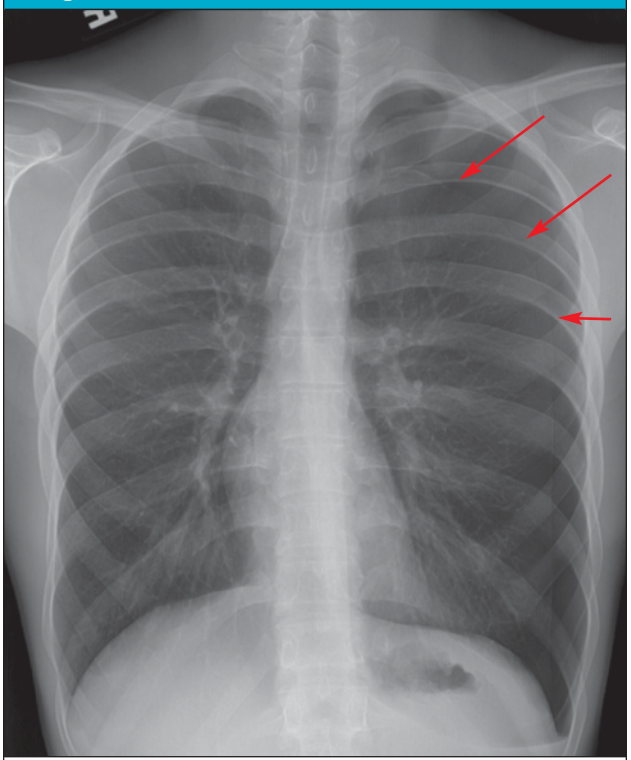
Image 1. Pneumothorax With Midline Shift



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6 months earlier—which was treated with a chest tube—presented to his local UC center after experiencing a similar sudden onset of sharp, left-sided chest pain. The pain started 1 hour prior while inhaling from a cigarette he was smoking. The patient also complained of shortness of breath and dizziness. He denied fever, cough, or other preceding symptoms.

In UC, his vital signs were: temperature 37.2°C; heart rate 105 beats per minute, respiratory rate 26 breaths per minute; blood pressure 94/72 mmHg; and oxygen saturation 96% on room air. On exam, the patient was alert and oriented but appeared anxious and diaphoretic. Cardiovascular examination revealed a regular tachycardia with no murmurs. He had symmetric breath sounds, and there was no wheezing or rhonchi. His thoracic excursion appeared normal with respiration. The abdomen was slightly distended but soft and nontender without rigidity, rebound, or guarding. Extremities showed no swelling or pain, and peripheral pulses were weak and thready.

Definition and Classification of Spontaneous Pneumothorax

A spontaneous PTX (**Image 1**) is defined as air trapped in the pleural space causing collapse of the underlying lung in situations without external trauma. Spontaneous PTX can be further divided into 2 subtypes: primary and secondary. While previously believed that primary spontaneous pneumothorax (PSP) occurred in patients without underlying lung disease, increasing evidence has cast doubt on this traditional conception. While patients with PSP may have no clinically apparent lung disease when it occurs, thoracic computed tomography (CT) imaging of patients affected with PSP shows evidence of pre-existing pleural porosity and emphysematous changes in the majority of cases.[1,2] The incidence of PSP is nearly 3 times greater in men than women.[3]

A secondary spontaneous pneumothorax (SSP), by contrast, occurs in patients with underlying lung pathology such as chronic obstructive pulmonary disease (COPD), cystic fibrosis, pneumonia, or tuberculosis.[4] Rarely, patients with endometriosis can develop extra-abdominal endometrial implants in the thoracic cavity, which can lead to SSP; this phenomenon is termed catemenial pneumothorax.[4,5] Patients with SSP typically present with more severe symptoms than patients with PSP. In PSP, the patient's unaffected lung is functionally normal and can compensate for the loss of function in the affected lung.[4] Patients with SSP tend to be older than patients with PSP (58 years vs 28 years, in 1 study) and, by definition also having pre-morbid clinical pulmonary disease.[6] SSP will recur in over 50% of affected patients.[7] While PSP recurs less commonly than SSP, patients are still at up to a 41% risk for recurrence in the 12 months following the episode.[8]

Relevant Anatomy and Pathophysiology

The visceral pleura lines the external surface of the lung and, in the setting of normal physiology is in close contact with the parietal pleura, which lines the thoracic cavity. In normal physiologic conditions, the pleural space is free of air, and hydrostatic forces balanced with lymphatic resorption keep the total pleural fluid volume under 10 mL.[9]

PSP is caused by blebs, bullae, and subclinical emphysematous changes at the periphery of the lung near the pleural border.[10] SSP is most commonly related to COPD, interstitial lung disease/pulmonary fibrosis in older patients[11] and pneumonia, pulmonary tuberculosis, connective tissue disorders (eg, Marfan's syndrome), and cystic fibrosis in younger patients.[12] In either case, a rupture of subpleural lung parenchyma allows air to escape into the pleural space producing a spontaneous PTX.[13]

A tension PTX (**Image 2**) occurs when the pressure within the pleural space exceeds atmospheric pressure throughout all phases of respiration. This pressure, consequently, impairs venous return and cardiac filling and can progress to obstructive shock, if untreated.[14] Given that atmospheric pressure is the force driving air into the pleural space when there is a defect, tension physiology in the setting of spontaneous PTX is a rare occurrence.[14,15]

History

Patients with PSP most commonly present with a sudden-onset pleuritic chest pain, with or without breathlessness, and occasionally shoulder pain and cough.[16] PSP occurs at rest in 80% of cases and most frequently affects tall, thin males between the ages of 15 and 34 years, whereas SSP is more prevalent in individuals patients >50 years of age.[5]

Physical Examination

PSP typically presents with diminished or absent breath sounds and reduced ipsilateral chest expansion. Hyperresonance on percussion may also be present. These findings are not universally present and, therefore, the diagnosis requires imaging due to variability in symptoms and signs.[5] Hemodynamic compromise and significant hypoxia are uncommon, and vital signs may be normal, particularly in patients with PSP.[16]

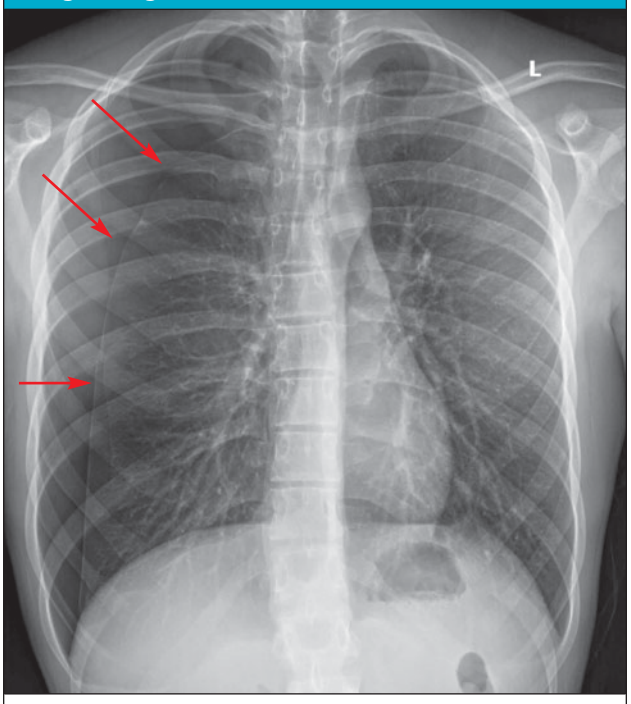
Tension PTX rarely occurs in cases of spontaneous PTX and is more common in patients with traumatic PTX and/or use of positive pressure ventilation.[15] Clues suggesting the possibility of tension physiology include marked tachypnea, tachycardia, hypotension, tracheal deviation away from the affected side, jugular venous distention.[17] If patients have concerning signs of tension PTX, EMS activation should not be delayed for radiographic conformation.[17]

Testing

Plain Radiography

The European Respiratory Society task force guidelines recommend an upright posterior-anterior (PA) chest radiograph as the preferred initial imaging study for diagnosing suspected PTX.[5] PTX is often less apparent on a lateral view CXR, but obtaining 2 views can be helpful in the evaluation for alternate diagnoses.[18] The hallmark radiographic finding for the diagnosis of PTX is displacement of the pleural line away from the chest wall, which is seen as an absence of peripheral lung markings.[5] In an upright film, this finding is most often visible at the apex as the pleural gas tends to move cephalad while the pleural fluid moves caudally due to gravity.[5,19]

Image 2. Right Tension Pneumothorax



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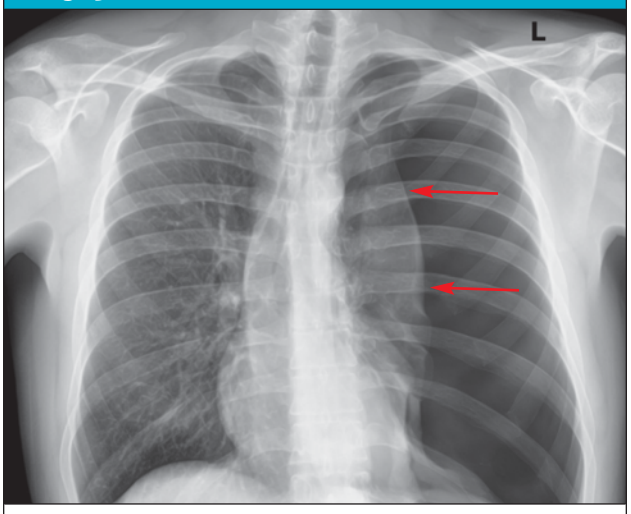
Ultrasound

The value of bedside ultrasound in the evaluation of possible PTX has become increasingly apparent over recent decades. The American College of Emergency Physicians recognizes POCUS as a core application in the evaluation for suspected PTX, emphasizing its ability to provide rapid, bedside diagnosis and guide clinical decision-making in emergency settings.[20] A 2023 study demonstrated that POCUS using a linear probe had higher sensitivity (95.2%) and comparable specificity (97.3%) when compared to CXR for the diagnosis of PTX. While highly specific (97-99%), CXR sensitivity for PTX ranges from 52-73%.[21] Given shortages of radiology technicians in the U.S. and superior test characteristics, PTX evaluation is among the more compelling arguments for POCUS in the UC setting.[22] Lung ultrasound for PTX is among the more straightforward POCUS applications, and trainees have been shown to achieve proficiency with fewer than 10 supervised exams.[23] Lung POCUS has also been shown to be more accurate for predicting which patients with PTX require tube thoracostomy.[24]

Other Imaging Modalities

While rarely available in UC settings, chest CT is the gold standard for the diagnosis of PTX.[25] However, with

Image 3. Left Tension Pneumothorax



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a sensitivity of 100% for even small pneumothoraces, the extreme sensitivity of modern CT scanners for PTX can also lead to clinical conundrums and overtreatment of clinically insignificant pneumothoraces.[26]

Diagnostic Dilemmas

Signs and symptoms of spontaneous PTX overlap with many other "can't miss" diagnoses including aortic dissection, acute coronary syndrome, pneumonia, pericardial tamponade, and pulmonary embolism.[27,28,29] Given limitations in diagnostic testing available in the UC setting, coupled with the insensitivity of CXR for PTX, it is likely that many patients with sharp chest pain and/or dyspnea will require ED referral without a definitive diagnosis. It is important that ED referral is not delayed in such patients if there are concerning vital sign abnormalities or other findings suggesting that the patient is unstable.

Frequently, patients with COPD can develop pulmonary bullae. On CXR, these bullae may be confused for PTX.[30] Clinically, COPD exacerbations generally present more insidiously than SSP with progressive dyspnea, increasing cough, and sputum production over hours-days.[31] In cases where a bulla versus PTX are both considered possible, it is helpful to compare the patient's CXR with a prior study when available. ED referral is warranted in cases of diagnostic uncertainty, so that the patient may be observed and advanced imaging obtained with the guidance of specialist consultation. Additionally, a ruptured bulla in a patient with COPD may produce a SSP.[32] Such patients have little pulmonary reserve and may deteriorate quickly. This possibility should be considered in patients with atypical COPD exacerbations and (unlike asthma) underscores the importance of CXR for all cases of suspected COPD exacerbation.[33]

Urgent Care Disposition

Management of PTX varies based on the patient's clinical presentation, co-morbidities, and follow-up. No guidelines exist for the UC management of patients with spontaneous PTX. A 2020 study of ambulatory care patients with PSP showed that patients managed conservatively (ie, without pleural decompression/thoracostomy) had fewer hospital days but more frequent adverse events.[34] Conversersely, another 2020 randomized controlled trial of patients with PSP found a higher rates of complications in patients treated interventionally compared to observation.[35] Interventional management was also associated with significantly higher rates of PTX recurrence (17% vs. 5%).[35] The use of smaller chest tubes and Heimlich valves (HV) has become increasingly adopted.[36] The HV has been shown to be effective in over 80% of spontaneous PTX and allows for PTX decompression without a water seal device in the outpatient setting.[36]

While conservative outpatient management is becoming increasingly preferred for small, spontaneous pneumothoraces in hemodynamically stable patients, studies typically suggest that CXR is repeated in 3-6 hours after initial diagnosis to confirm the PTX is not expanding.[13] As this is impractical in the UC setting, immediate ED referral upon identification of spontaneous PTX is recommended. Decisions regarding the need for additional imaging (eg, chest CT), decompression, and hospitalization are complex and typically undertaken in close consultation with an appropriate specialist. Additionally, many patients with PTX are treated with supplemental oxygen even in the absence of hypoxemia.[36] These logistical hurdles create further barriers to safe UC discharge, even for healthy, stable patients, in the absence of direct specialist guidance.

Management of Unstable Patients

While immediate ED referral is the most practical disposition for the vast majority of UC patients with spontaneous PTX, many patients may not require EMS transport. Patients with significant symptoms, such as severe chest pain or dyspnea, or evidence of physiologic instability—which includes systolic blood pressure <90 mmHg, persistent or progressive tachycardia, significant tachypnea (ie, respiratory rate >30 bpm), and/or oxygen saturation <92% on room air—warrant immediate EMS

activation.[34,35] Additionally, patients with evidence of tension pneumothorax need to be transferred to ED immediately for urgent decompression.

While exceedingly rare in cases of spontaneous PTX, tension PTX in these settings have been reported.[15] In patients with progressive tachycardia, hypoxemia (or oxygen requirements), and/or hypotension, immediate needle thoracostomy to decompress the affected hemithorax should be considered.[37] The optimal location for needle decompression has been debated, however, a recent cadaveric study found the pleural space was accessed with significantly greater accuracy when a 14-gauge angiocatheter was placed in the fifth intercostal space at the anterior axillary line compared to the second intercostal space at the mid-clavicular line.[38]

Definitive Management

For patients with spontaneous PTX who have persistent air leak, recurrence, and/or failure of the lung to re-expand after an appropriate period of observation, chemical pleurodesis or thoracic surgery may be considered.[39] Follow-up with a thoracic surgeon for review of the various treatment options is indicated for patients with spontaneous PTX after ED or hospital discharge.[36]

Next Level Urgent Care Pearls

- Patients with sponaneous PTX may have symmetric lung sounds and normal vital signs. Do not rely on physical exam alone to exclude spontaneous PTX.
- Patients with COPD may develop bullous lung disease. On CXR, this may be mistaken for PTX. Comparison with a historic CXR is useful in such cases.
- COPD exacerbations usually present with a relatively gradual decline in condition. Sudden deterioration may suggest a ruptured bullae with spontaneous PTX.
- A "normal" CXR does not exclude PTX. CXR is only 52-73% sensitive for PTX. Sensitivity is enhanced by ensuring images are acquired with the patient upright.
- Lung POCUS can be quickly learned. The sensitivity of POCUS for PTX is >95% when performed by appropriately trained clinicians.
- Needle decompression can be life-saving in the rare instances of tension PTX, which can arise after spontaneous PTX. The most successful approach for needle decompression involves using a 14-gauge angiocatheter in the fifth intercostal space at the anterior axillary line.

Clinical Scenario Conclusion

The patient had a 2 view upright CXR in UC which confirmed a small left apical PTX. Given the patient's tachycardia, the treating UC clinician suggested activating EMS would be safest. The patient declined ambulance transport and opted instead to have his wife drive him to the ED of the hospital where he had been previously treated.

In the ED, the patient underwent repeat CXR that showed a stable PTX. He was placed on supplemental oxygen through a facemask and admitted to the thoracic surgery service. His PTX progressed somewhat on repeat imaging the following day, and he was treated with decompression with a small pigtail catheter with a Heimlich valve and discharged to follow-up in clinic. After 3 days, his PTX was no longer apparent on CXR, and the chest catheter was removed. He underwent semi-elective pleurodesis one month later to mitigate the risk of future recurrences.

Takeaway Points

- Common presenting symptoms of PTX include sudden-onset pleuritic chest pain, shortness of breath, and occasionally shoulder pain or cough.
- PSP occurs in younger patients without clinically evident lung disease, whereas SSP occurs in older patients with lower physiologic reserve.
- Both PSP and SSP have high rates of recurrence, especially in the months following the initial episode.
- On exam, diminished or absent breath sounds and hyper-resonance on percussion of the affected side and/or reduced chest expansion may be present. Patients may have tachypnea, hypoxemia, and/or tachycardia. However, patients (particularly those with PSP) may also have normal vital signs and physical exam.
- While rare, tension PTX can occur in cases of both SSP and PSP. If patients have vital signs suggestive of shock, do not delay EMS activation. In settings with prolonged EMS response times, UC clinicians may be compelled to perform needle decompression of the hemithorax in cases where a patient's condition is rapidly declining.
- POCUS evaluation can be easily learned and has higher sensitivity and comparable specificity for diagnosing PTX when compared to CXR.
- CXR findings include the displacement of the pleural line away from the chest wall and the absence of lung markings beyond the pleural line.
- Conservative management is increasingly being recommended for stable patients, as it is associated with fewer adverse events, reduced risk of recurrence, and a lower need for surgical interventions in patients

with PSP.

- In the absence of direct specialist guidance, it is prudent for UC clinicians to refer all patients diagnosed with spontaneous PTX to a nearby ED with surgical specialist coverage. ■

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