



<http://dx.doi.org/10.1016/j.jemermed.2017.02.008>

Ultrasound in Emergency Medicine

ULTRASOUND FINDINGS IN TENSION PNEUMOTHORAX: A CASE REPORT

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Abstract—Background: Delayed recognition of tension pneumothorax can lead to a mortality of 31% to 91%. However, the classic physical examination findings of tracheal deviation and distended neck veins are poorly sensitive in the diagnosis of tension pneumothorax. Point-of-care ultrasound is accurate in identifying the presence of pneumothorax, but sonographic findings of tension pneumothorax are less well described. **Case Report:** We report the case of a 21-year-old man with sudden-onset left-sided chest pain. He was clinically stable without hypoxia or hypotension, and the initial chest x-ray study showed a large pneumothorax without mediastinal shift. While the patient was awaiting tube thoracostomy, a point-of-care ultrasound demonstrated findings of mediastinal shift and a dilated inferior vena cava (IVC) concerning for tension physiology, even though the patient remained hemodynamically stable. **Why Should an Emergency Physician Be Aware of This?:** This case demonstrates a unique clinical scenario of ultrasound evidence of tension physiology in a clinically stable patient. Although this patient was well appearing without hypotension, respiratory distress, tracheal deviation, or distended neck veins, point-of-care ultrasound revealed mediastinal shift and a plethoric IVC. Given that the classic clinical signs of tension pneumothorax are not uniformly present, this case shows how point-of-care ultrasound may diagnose tension pneumothorax before clinical decompensation. **Published by Elsevier Inc.**

Keywords—tension pneumothorax; shock; ultrasound findings; emergency medicine

INTRODUCTION

Tension pneumothorax is a feared complication of pneumothorax, caused by a one-way mechanism that facilitates the accumulation of gas into the pleural space during inspiration, but prevents the exit of gas from the pleural space during expiration. Left untreated, tension pneumothorax leads to cardiovascular collapse and death, but the precise pathophysiology underlying this progression is complex. Initially, it was theorized that increased intrathoracic pressures caused mechanical “kinking” of the mediastinum, leading to decreased venous return and ultimately hypotension (1). However, recent studies reveal that, in some cases, central hypoxia from pulmonary collapse is the primary pathology, and cardiac output and blood pressure are maintained until respiratory arrest (2). This theory may explain how one can see signs of mediastinal shift without observable clinical decline.

With early recognition and treatment, the mortality of tension pneumothorax ranges from 3% to 7%; delayed recognition can lead to mortality of 31% to 91% (3,4). However, the classic physical examination findings of tracheal deviation and distended neck veins have been shown to be poorly sensitive in the diagnosis of tension pneumothorax, with a sensitivity of 17.9% and 4.7%, respectively (5). Furthermore, in case reports of awake patients with tension pneumothorax, < 25% of

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RECEIVED: 31 December 2016;

ACCEPTED: 14 February 2017

cases displayed hypotension (4). Point-of-care ultrasound has been shown to be helpful in identifying pneumothorax, as well as the etiology of undifferentiated hypotension, such as tension pneumothorax (6). In cases of tension pneumothorax, bedside ultrasound can help identify tension physiology before hypotension or hypoxia. We report a case of a well-appearing patient who was noted to have sonographic evidence of tension pneumothorax.

CASE REPORT

A 21-year-old man presented to the emergency department (ED) with sudden-onset left-sided chest pain. The pain started earlier that day when the patient was driving and accelerated suddenly, causing him to hit his seat forcefully. The patient went to his primary care physician who ordered an outpatient chest x-ray (CXR) study, which revealed a left-sided pneumothorax without mediastinal shift. The patient was instructed to proceed to the nearest ED. In the ED, the patient continued to report non-radiating, left-sided, pleuritic chest pain and mild shortness of breath. He had experienced a similar episode 4 days before presentation, however, that episode was less intense and resolved spontaneously. The patient denied previous medical problems or family history of pneumothorax, and the review of systems was negative for fever, cough, dizziness, or syncope.

The patient's vital signs were: temperature of 37°C, blood pressure 119/82 mm Hg, pulse 102 beats/min, respiratory rate 20 breaths/min, and oxygen saturation of 95% on room air. The patient was not in respiratory distress; breath sounds were decreased on the left side. The remainder of the physical examination was normal. A posterior–anterior CXR showed a large left pneumothorax with complete collapse of the left lung, without mediastinal shift (Figure 1). Immediate tube thoracostomy was intended for the patient, however, placement was delayed due to an influx of critical patients in the ED.

Sixty minutes after the CXR, a point-of-care ultrasound was performed to show medical students ultrasound findings in pneumothorax. At this time, the patient's vitals remained about the same: blood pressure 116/90 mm Hg, pulse 106 beats/min, respiratory rate 23 breaths/min, and oxygen saturation of 100% on a non-rebreather oxygen mask. The patient was supine and evaluation of the anterior lung fields with a linear transducer (13-6 MHz) revealed normal lung sliding on the right and absent lung sliding on the left (Figure 2). The sonographers subsequently performed a focused echocardiogram with a phased array transducer (5-1 MHz), but the heart was not visualized on the left side of the chest. Parasternal cardiac windows were obtained by placing the probe on the right side of the sternum at the fourth intercostal space. Surprisingly,



Figure 1. Anterior-posterior chest x-ray study showing large left-sided pneumothorax without mediastinal shift.

a parasternal short view was obtained with the indicator toward the patient's left hip (Figure 3) and a modified parasternal long view was obtained with the indicator toward the patient's right hip (Video Clip 1), presumably due to increased left thoracic pressure altering the normal axis of the heart. The echocardiogram showed no pericardial effusion, normal left ventricular ejection fraction, and no right ventricular strain. The inferior vena cava (IVC) was visualized inferior to the diaphragm in the midline sagittal plane. It appeared plethoric with a diameter of 2.8 cm and minimal inspiratory collapse (Figure 4).

The patient's primary team was informed of the ultrasound findings of mediastinal shift and a dilated IVC, concerning for a tension pneumothorax. The providers placed a chest tube immediately. After chest tube placement, repeat lung ultrasound revealed normal lung sliding bilaterally. Repeat focused echocardiography demonstrated

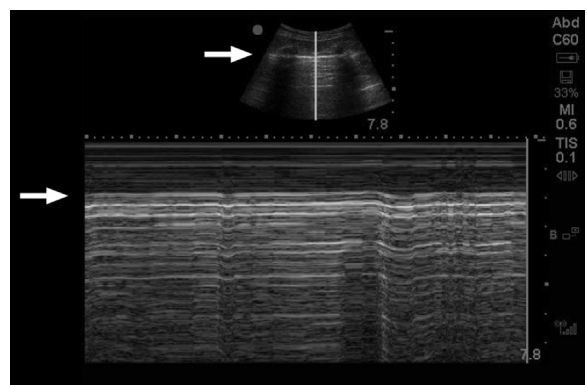


Figure 2. M-mode image of left chest showing pleural line (arrow) and linear pattern in M-mode (i.e., "barcode sign") demonstrating no movement of the visceral and parietal pleura.

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