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CASE REPORTS

Pneumomediastinum Diagnosed on Ultrasound in the Emergency Department: A Case Report

Hilary FH Beason, MD; Joshua E Markowitz, MD, RDMS, FACEP

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ABSTRACT

An emergency ultrasound performed at bedside helped to confirm and expedite the diagnosis of esophageal perforation in a 23-year-old man. Early diagnosis was essential for prompt treatment and consultation because the patient's underlying pathology created the potential for him to become critically ill. By serving as a quick, bedside tool for the diagnosis and evaluation of patients in the Emergency Department, bedside ultrasound allows emergency physicians to care for critically ill patients without delays or the need to send patients out of the department for imaging studies. Although the use of ultrasound in diagnosing soft-tissue pathologies is a core competency, the diagnosis of pneumomediastinum by ultrasound has been reported in the literature in only a few case reports. To our knowledge, this is the first published report of using ultrasound as an aid in the diagnosis of Boerhaave syndrome by diagnosing pneumomediastinum in an adult male.

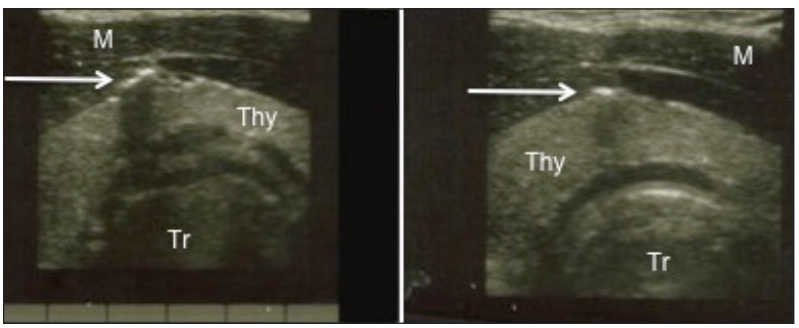

Figure 1. Ultrasound of the neck. The white arrow indicates free air with posterior acoustic shadowing in the soft tissue of the neck. Free air is identified by the hyperechoic white spots. The white "M" indicates sternohyoid and sternothyroid muscles. The white "Thy" indicates the thyroid. The white "Tr" indicates the trachea.

INTRODUCTION

Ultrasound is an essential tool for emergency physicians because of its use for diagnosis, resuscitation, monitoring, and adjunct treatment in core areas of practice, including trauma, deep vein thrombosis, and thoracic, abdominal, and soft-tissue pathologies.[1,2] This article presents a case in which the use of bedside ultrasound aided in a prompt diagnosis of pneumomediastinum, which led to a diagnosis of postemesis esophageal rupture. Cases of esophageal rupture have a high risk of morbidity and mortality, and early, definitive diagnosis leading to definitive management improves outcomes. Definitive diagnosis is most often made with imaging, including x-ray and computed tomography scans. These modalities may lead to delays in diagnosis or, in many cases, may require the potentially unstable patient to leave the Emergency Department (ED). This case demonstrates that with a high degree of clinical suspicion and utilization of bedside ultrasound, the emergency physician may 1) more confidently provide earlier interventions including antibiotics and surgical consult, and 2) limit time out away from the department (for imaging) in a patient who may be critically ill.

CASE REPORT

A 23-year-old man with a history of asthma and alcohol and marijuana use presented to the ED with 2 hours of severe, sharp right-sided chest pain. The pain started suddenly after the patient choked on a large piece of steak and subsequently coughed once and vomited forcefully. On physical examination, the patient appeared uncomfortable and was noted to have reproducible tenderness over the right anterior chest wall and anterior neck. Initially, no other findings on physical exam were noted, but on repeat evaluation after an echocardiogram was performed, the patient had crepitus over his anterior neck. No other positive physical findings were noted. His echocardiogram showed normal sinus rhythm.

Using a SonoSite MicroMaxx (SonoSite, Inc, Bothell, WA) machine and a P38 probe, a bedside ultrasound of the soft tissue of the neck was performed 26 minutes later to confirm the physical examination finding of crepitus over the anterior neck. Examination of the anterior neck revealed subcutaneous hyperechoic white foci suggestive of air bubbles in the soft tissue (Figure 1). After confirmation of free air in his anterior neck, the patient was given a diagnosis of subcutaneous air from a presumed pneumomediastinum and a diagnosis of likely esophageal rupture consistent with Boerhaave syndrome. The patient was started on piperacillin/tazobactam. Portable x-ray was not

Hilary FH Beason, MD, is an Emergency Physician at the DCH Health System Medical Center in Tuscaloosa, AL. E-mail: sheofdg@aol.com. **Joshua E Markowitz, MD, RDMS, FACEP**, is an Emergency Physician at the Santa Clara Medical Center in CA. E-mail: joshuamarkowitzmd@gmail.com.

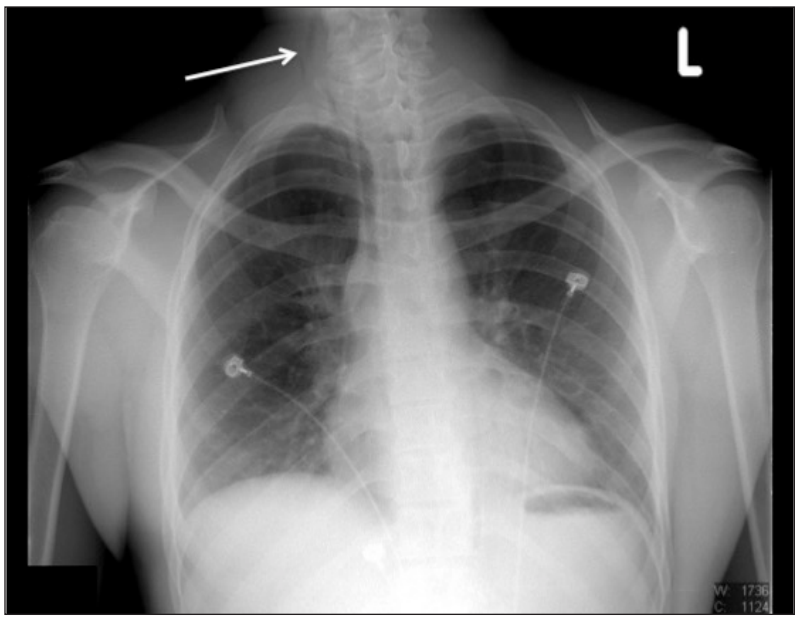

Figure 2. Radiograph of the chest. The white arrow indicates free air in the soft tissues of the neck.

initially available; a chest radiograph was obtained 2 hours and 13 minutes after presentation to the ED (Figure 2). The on-call surgeon was notified of the radiograph findings and the patient was admitted to the Surgical Intensive Care Unit. The diagnosis of pneumomediastinum was further evaluated using a computed tomography scan with contrast (Figure 3), and eventually with an esophagram from the Surgical Intensive Care Unit. These images demonstrated a right pleural effusion, mild emphysema and pneumomediastinum in the chest, and subcutaneous emphysema, in the neck. On the day after admission to the ED, a repeat esophagram was performed that showed that the patient's perforation had spontaneously closed. The patient was managed medically and was discharged home on hospital day 2.

DISCUSSION

Boerhaave syndrome is defined as spontaneous transmural rupture and perforation of the esophagus or postemesis esophageal rupture.[3,4] The most common causes of esophageal rupture include chest trauma (blunt or penetrating), local trauma from swallowed foreign bodies or caustic agents, spontaneous rupture, anastamotic breakdown, and iatrogenesis.[3] Boerhaave syndrome has a high rate of morbidity and mortality due to mediastinal contamination, with 20% to 50% of cases resulting in death even when properly treated.[3,5] If a significant esophageal tear occurs, the definitive management is surgical.[3,4]

In our case, the patient reported forceful vomiting, which probably caused the esophageal perforation. Our patient had only a small perforation, which closed spontaneously and required no surgical intervention. However, prompt diagnosis was aided by bedside ultrasound, allowing for the early initiation of antibiotic therapy. These were critical steps in this patient's hospital course. The physical examination finding of crepitus raised our suspicion for free air; ultrasound confirmed this finding, which, in conjunction with the patient's presenting history, led to a presumptive diagnosis of pneumomediastinum.

The diagnosis of Boerhaave syndrome requires a high clinical suspicion and can often be overlooked. Patients typically present with severe chest or abdominal pain that can mirror other pathologies, thus causing early examination findings to be nonspecific. The classic physical findings associated with Boerhaave syndrome often present late and include a systolic crunch (Hamman sign) and crepitus that is palpable in the neck or along the chest wall.[3] Common chest x-ray findings include widening of the mediastinum, pneumothorax, pneumomediastinum, and/or pleural effusions (usually left-sided).[3,4]

Emergency ultrasound is an accepted practice for the primary assessment of ED patients.[6] Although ultrasound may not be able to definitively diagnose Boerhaave syndrome, sonography has been used to identify some of its common features. Using sonography in the diagnosis of pneumothorax and pleural effusion is common practice. Ultrasound has also been used to identify subcutaneous air bubbles in necrotizing fasciitis and subcutaneous air caused by surgical procedures.[7,8] However, the ability to diagnose pneumomediastinum with ultrasound has only been reported in a few case reports and is more often associated with children.[9-13]

The diagnosis of pneumomediastinum can be challenging with bedside ultrasound and is operator dependent. Thoracic ultrasound poses its own challenges because of limitations caused by bone and by air in the lungs. However, the ability to visualize free air in the soft tissue of the neck is often more straight forward. Differential diagnoses to consider for free air in the neck include

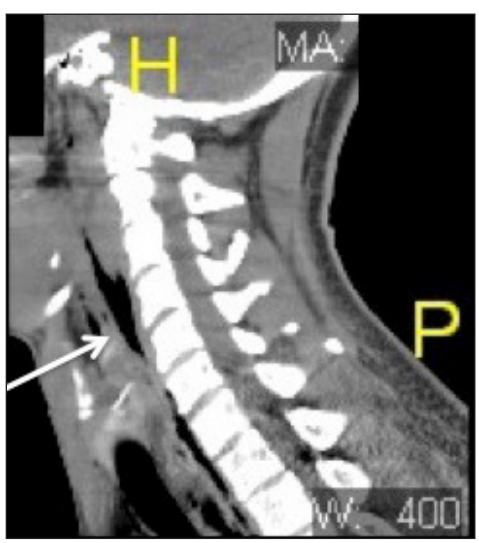

Figure 3. Computed tomography scan of the neck with contrast. The white arrow indicates free air in the prevertebral space.

direct local extension (such as from a line placement), infection from a gas-producing bacteria, pneumothorax, or pneumomediastinum. In our case, use of ultrasound led to early treatment and allowed for close patient monitoring before the patient left the department for further imaging. In an unstable patient, transportation to the Radiology Department would increase risk to the patient, and the use of ultrasound could make an even greater difference in patient mortality.

Our patient was young and of appropriate body mass index, which allowed for the thorough physical examination that identified crepitus in his neck. In patients with severely elevated body mass indexes and those considered morbidly obese, findings such as subcutaneous emphysema may be equivocal or even absent on palpation, thus making it more difficult to properly diagnose this condition. In these cases, ultrasound is an even greater tool for identifying subcutaneous air because it can have greater sensitivity than physical examination alone.

Many facilities have access to portable x-ray machines, a useful tool in diagnosing free air in the soft tissues. However, there are occasions when this modality may be unavailable. Some EDs may not have access to portable x-ray machines at all. In either of these cases, the ability to use ultrasound becomes crucial in helping to identify and to diagnose emergent conditions. Although it may not be the only imaging modality that can diagnose free air, ultrasound may compliment current available technology because there are times when it is the most accessible imaging modality.

Early intervention reduces morbidity and mortality in cases of Boerhaave syndrome. The use of ultrasound at bedside can help lead to early diagnosis of certain aspects of the syndrome, such as pneumomediastinum. Although definitive imaging such as computed tomography and barium esophagram may still be required, particularly before surgical intervention, bedside diagnosis with ultrasound allows for prompt initiation of antibiotics, critical in the treatment of Boerhaave syndrome. ❖

Disclosure Statement

The author(s) have no conflict of interest to disclose.

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