

Thoracic Ultrasonography

Viveta Lobo, MD^{a,*}, Daniel Weingrow, DO^b,
Phillips Perera, MD, RDMS^a, Sarah R. Williams, MD^a,
Laleh Gharahbaghian, MD^a

KEYWORDS

- Thoracic ultrasound • Lung ultrasound • Emergency ultrasound • Pleural effusion
- Thoracentesis • Pneumothorax • Pulmonary edema • Pneumonia

KEY POINTS

- Thoracic ultrasonography (US) provides a better and faster diagnostic alternative to traditional radiographic techniques in the dyspneic and critically ill patient.
- Traditional resources on bedside US emphasize that the lung is not an organ amenable to US evaluation. Over the last few years, this claim has been shown to be false, and many pulmonary applications have become widely prevalent in clinical use.
- US can be used in the evaluation for pneumothorax, pleural effusions, pulmonary edema, acute respiratory distress syndrome, pneumonia, chronic obstructive pulmonary disease, lung masses, and contusions.
- Using US guidance during a thoracentesis decreases the associated complication rate. In addition, US techniques have been developed to assess for endotracheal placement after intubation attempts.

INTRODUCTION: THORACIC ULTRASONOGRAPHY - ITS HISTORY AND EVOLUTION

In the past, ultrasonography (US) was a relatively neglected aspect of bedside emergency ultrasound (EUS). Due to increased resistance in the passage of sound waves through the air-filled lung, image acquisition and interpretation can be challenging. However, sound waves can easily travel through fluid-filled areas of the chest. Thus, US is more sensitive than chest radiographs for detecting disease such as pleural effusions.¹ In addition, US guidance has been found to offer a dramatic decrease in the complication rate of thoracentesis performed at the bedside.²

Funding Sources: None.

Conflict of Interest: V. Lobo, D. Weingrow, S.R. Williams, L. Gharahbaghian: None; P. Perera, Educational consultant: SonoSite Ultrasound.

^a Division of Emergency Medicine, Department of Surgery, Stanford University Medical Center, 300 Pasteur Drive Alway M121, Stanford, CA 93405, USA; ^b Department of Emergency Medicine, UCLA Olive View/Ronald Reagan Medical Center, 14445 Olive View Drive, North Annex, Sylmar, CA 91342, USA

* Corresponding author.

E-mail address: vlobo@stanford.edu

Crit Care Clin 30 (2014) 93–117

<http://dx.doi.org/10.1016/j.ccc.2013.08.002>

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Critical care physicians, such as Daniel Lichtenstein and others, subsequently demonstrated that the air-filled lung could successfully be evaluated for specific types of pathology and further developed lung US to expand the previously defined group of applications. In 1995, an important study was published that documented the utility of lung US for the diagnosis of pneumothorax (PTX).³ After this event, many subsequent studies have shown the effective use of US in the diagnosis of a myriad of lung diseases, including pulmonary edema, pneumonia (PNA), acute respiratory distress syndrome (ARDS), lung masses, and pulmonary contusion.^{4,5} Current research has also looked at the use of US in confirming endotracheal tube (ETT) placement following intubation attempts.⁶

CASE PRESENTATION

A 64-year-old woman with a history of hypertension, congestive heart failure (CHF), chronic obstructive pulmonary disease (COPD), and intravenous drug use (IVDU) presented to the emergency department (ED) with severe and sudden dyspnea, which progressed over 15 minutes while at rest. The patient did not have relief after paramedics administered albuterol by nebulizer, high-flow oxygen, aspirin, and nitroglycerin.

On evaluation, the patient was in obvious respiratory distress, in the tripod position, with prominent accessory muscle use. She was able to nod to corroborate the paramedic's history, and denied recent travel or trauma. Her vital signs included blood pressure of 180/100 mm Hg, heart rate of 120 beats per minute, respiratory rate of 32 breaths per minute, temperature of 99°F, and oxygen saturation of 90% on a 100% face mask. She was alert, responsive, and cooperative with treatments. On physical examination, she had jugular venous distension, diffuse wheezes with decreased breath sounds at the right base, tachycardia without murmurs, and bilateral peripheral lower extremity edema.

The differential diagnosis in this patient included CHF exacerbation with flash pulmonary edema, noncardiogenic pulmonary edema, COPD exacerbation, PTX, pericardial effusion with tamponade, pleural effusion, pulmonary embolism, acute myocardial infarction, and PNA. The patient was in a critical status with impending respiratory failure. The correct diagnosis must be made expeditiously and the appropriate treatment rendered immediately to avoid imminent decompensation. Bedside US can allow for a more accurate clinical assessment and provision of targeted therapy to better address the patient's acute condition.

BENEFITS OF THORACIC US

Dyspnea is a common complaint in the ED and is disproportionately involved in higher-acuity patients.⁷ The Centers for Disease Control document that more than 3.5 million visits each year are made to US EDs with a chief complaint of dyspnea.⁸ Accurate and rapid diagnosis is paramount to making correct treatment and disposition decisions. Dyspneic patients often find it difficult to relate the full details of their history. Furthermore, their physical examination findings often have poor accuracy and interrater reliability.⁹ Complicating things further, patients with extreme dyspnea often cannot safely leave the ED for advanced imaging tests. Portable radiographs may be ordered, but often take precious time. Many portable chest radiographs are performed with the patient in the supine position, because of trauma or hypotension, making accurate interpretation more difficult. Mastery of point-of-care bedside US in these dyspneic patients can lead to quick and accurate diagnosis, avoiding treatment delay.^{10,11}

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