

COMMENTARY

# Using lung ultrasound to differentiate patients in acute dyspnea in the prehospital emergency setting

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See related research by Prosen *et al.*, <http://ccforum.com/content/15/2/R114>

## Abstract

The diagnosis and treatment of dyspnea in the emergency department and in the prehospital setting is a challenge faced by the emergency physician and other prehospital care providers. While the use of lung ultrasound as a diagnostic tool in dyspneic patients has been well researched, there has been limited evaluation of its use in the prehospital setting. In the previous issue of *Critical Care*, Prosen and colleagues study the accuracy of lung ultrasound compared with both N-terminal pro-brain natriuretic peptide and the clinical examination for differentiating between acute decompensated congestive heart failure and chronic obstructive pulmonary disease exacerbations for patients in the prehospital setting. Their article adds to the growing body of evidence demonstrating the diagnostic efficacy of lung ultrasound in differentiating between these two disease processes in the acutely dyspneic patient.

Acute dyspnea is a common, and often challenging, complaint both in the emergency department and in the prehospital setting. The physician or other care provider must often make treatment decisions based on limited information, without the time or resources to obtain diagnostic test results to help focus treatment. There has been growing interest and evidence supporting the use of lung ultrasound as a diagnostic tool to help differentiate the various causes of dyspnea, most specifically between patients with acute congestive heart failure and those with chronic obstructive pulmonary disease and asthma [1-5]. The current paper by Prosen and colleagues

expands on previous work by evaluating the utility of ultrasound in the prehospital setting [1]. Their article is the first study to assess the utility of lung ultrasound compared with point of care N-terminal pro-brain natriuretic peptide as well as specific clinical examination findings in the prehospital setting.

Unlike other forms of ultrasonography, lung ultrasound relies on the visualization of artifacts. Two artifacts, A-lines and B-lines, are fundamental in the use of lung ultrasound. A-lines are bright horizontal hyperechoic lines deep to the pleural line that occur at regular intervals. These lines occur when the lung is well aerated and are a reverberation artifact. B-lines appear as vertical lines extending downward from the pleural line to the bottom of the ultrasound screen. B-lines appear when the interstitium becomes thickened with edema so that sound waves can now be reflected and refracted (instead of scattered) before returning to the probe.

Prosen and colleagues found that seeing B-lines on the initial lung ultrasound had 100% sensitivity, 95% specificity, 100% negative predictive value, and 96% positive predictive value for the diagnosis of heart failure in the prehospital setting. This was significantly superior to both N-terminal pro-brain natriuretic peptide (92% sensitivity and 89% specificity) as well as clinical examination (85% sensitivity and 86% specificity). One limitation of the current study is that the authors excluded patients who presented with noncongestive heart failure/chronic obstructive pulmonary disease causes of dyspnea such as pneumonia, pulmonary embolus, pneumothorax, and pleural effusion. While pneumothorax and pleural effusion have been shown to be readily and accurately identified by lung ultrasound [6,7], it has also been shown that patients with focal infiltrates can have focal B-line patterns [8]. Including all patients with dyspnea will be important for further studies to truly characterize the utility of lung ultrasound in this setting.

More importantly, this study highlights the feasibility and ease of performing lung ultrasound. The lung ultrasound technique was feasible in 100% of patients in this

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study and all examinations took less than 1 minute to perform. This speed is one of the greatest strengths of lung ultrasound. Lung ultrasound is a diagnostic skill that can be easily performed, easily learned and used accurately [8,9] – yet looking at outcomes will be important. There has been some evidence that the use of lung sonography has decreased the utilization of chest radiographs and computed tomography scans in the inpatient setting [10], so looking at outcomes and cost-effectiveness in the outpatient setting would be very interesting. Moreover, it would also be interesting to look at the efficacy of diagnostic lung ultrasound in settings where currently no diagnostic imaging is available – either because of geographical isolation or because of resource limitation. Given the relative steep learning curve for lung sonography and its reproducibility among users [9], the ability to make accurate diagnoses in the dyspneic patient when other diagnostic imaging is not available is a real medical advance.

In summary, the current study by Prosen and colleagues adds to the literature supporting the use of lung ultrasound in differentiating patients presenting with acute dyspnea. Lung ultrasound is an efficient, safe, feasible, and highly sensitive and specific test to aid in the diagnosis of the acutely dyspneic patient. This technique is a diagnostic modality extremely well suited to the prehospital setting, whether staffed by emergency physicians, paramedics, or other healthcare professionals. Further research, training, and application of lung ultrasound in the prehospital setting are warranted and are an exciting advancement for the field of emergency ultrasound.

#### Competing interests

The authors declare that they have no competing interests.

Published: 26 May 2011

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doi:10.1186/cc10226

**Cite this article as:** Rempell JS, Noble VE: Using lung ultrasound to differentiate patients in acute dyspnea in the prehospital emergency setting. *Critical Care* 2011, **15**:161.