

MORNING REPORT

COUGH IN A PATIENT WITH HEART FAILURE: TO B OR NOT TO B (LINES)

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(Discussant text in italics)

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Case

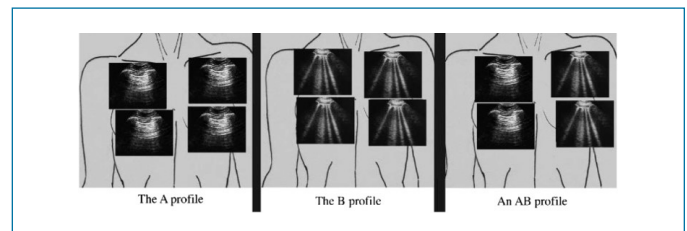
A 50-year-old man with heart failure (HF) presents with cough and generalized malaise for two days.

In a patient with a history of HF, initial diagnoses to entertain for cough and malaise include infectious and cardiopulmonary etiologies (i.e., pulmonary edema). Further history and physical exam in conjunction with point of care ultrasound (POCUS) will help hone this differential diagnosis.

The patient was in his baseline state of health until he started to feel “terrible.” He reports mild dyspnea, difficulty tolerating a diet, nausea without vomiting, nonproductive cough, and fevers. He denies chest pain, palpitations, orthopnea, paroxysmal nocturnal dyspnea or weight gain. He is on multiple medications including bumetanide, but he has not taken his medications for two days. His other medical history is significant for coronary artery disease (CAD), coronary artery bypass grafting (CABG), HF with an ejection fraction (EF) of 30%, mechanical mitral valve repair, hypertension, hyperlipidemia, and type 2 diabetes mellitus. There is no family history of heart disease. He is a former smoker with no alcohol or drug use.

The presence of subjective fevers, generalized malaise, and cough suggests an infectious etiology, particularly pneumonia. In patients with HF, it may be difficult to distinguish between pneumonia and pulmonary edema. The physical exam for this patient will be important to assess for focal lung pathology or volume overload. POCUS is an adjunct to the physical exam to guide diagnosis and management by answering targeted clinical questions.³ The image demonstrates characteristic findings on lung POCUS.

The patient has a temperature of 102°F, blood pressure of 150/90 mm/Hg, heart rate of 77, respiratory rate of 22, and oxygen saturation of 94% on ambient air. He is in no acute distress, but appears uncomfortable. His



(Left: The A profile is predominant A lines—horizontal reflections of the pleura. Middle: The B profile is predominant B lines—vertical hyperechoic lines. Right: The AB profile represents focal B lines in only a distinct lung zone. Image adapted from Lichtenstein, et al, 2008.)

cardiac exam is unremarkable. Jugular venous pressure is difficult to appreciate. On lung exam he has crackles in the left lower base, with other fields clear to auscultation. He has trace pedal edema bilaterally. Labs reveal a leukocyte count of 15,000 cells/ μ L, a troponin of 0.47 ng/mL and a normal lactate. Renal function and coagulation studies are normal. Chest radiograph reveals an opacity of the left middle lung, cardiomegaly and mild pulmonary congestion. The patient is started on intravenous (IV) antibiotics for community acquired pneumonia (CAP) and admitted to the hospital.

The fever, crackles, leukocytosis and CXR findings are most concerning for CAP. Regardless of what we find on cardiopulmonary POCUS, this patient should receive antibiotics considering the high pre-test probability for pneumonia. The next management decision in this patient with HF is how to manage his intravascular volume. Options include IV fluids, holding of diuretics, continuing diuretics or IV diuresis. Without POCUS, we may argue for diuresis with the elevated blood pressure and crackles on pulmonary exam. Before performing our POCUS exam, it is important to consider our clinical

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POCUS Question	POCUS Findings	Interpretation	Management
Lung Profile?	A profile	Dry, aerated lungs	Fluids or diuretics
	B profile	Diffuse interstitial process	Diuresis
	Focal B or AB profile	Focal interstitial process	Fluids or hold diuretics
Consolidation?	Air bronchograms	Pneumonia, atelectasis	Antibiotics (likely)
	Subpleural consolidation	Pneumonia	
IVC size/ compressibility	IVC <2cm + < 50% collapsibility	Low/normal CVP	Fluids or hold diuretics
	IVC >2cm + > 50% collapsibility	High CVP	Diuresis
LV Function?	Low/Normal	Known HF	No Change
	Severely low	Worsening HF	Hold fluids or diuresis

(An example of the pre-POCUS clinical reasoning process. It is important to consider the POCUS question, potential findings and how they may be interpreted as part of the clinical picture and how they may change management.)

questions and how POCUS may change diagnosis and/or management (table 1). This illustrates the concept that POCUS is only one piece of clinical decision-making. It is important to consider our focused pre-scan questions in order to apply and integrate clinical reasoning. Additionally, if all anticipated POCUS findings would not result in a change in diagnosis or management, one might put less priority on the POCUS exam or might elect not to perform the POCUS exam at all.

Lung POCUS was performed at the bedside demonstrating a B-profile in the left apex, A-profile in the other visualized lung fields with no pleural effusions. Cardiac POCUS was technically difficult due to body habitus. The subcostal view revealed a decreased EF with evidence of an IVC diameter <2 cm with respiratory variation >50%.

These findings indicate the patient is volume tolerant. The presence of focal B-lines with an otherwise A-profile indicates that the primary lung pathology is a

focal process (i.e., CAP), rather than a diffuse interstitial process (i.e. pulmonary edema). Respiratory variation of the IVC estimates a low/normal central venous pressure (CVP) and further supports fluid administration if clinically necessary. It is important to note that if fluids are otherwise not felt to be clinically indicated, POCUS finding of a small and collapsing IVC alone should not prompt fluid administration.

The patient was admitted to the hospital and his home diuretics were held. He was not administered IV

fluids as he was tolerating oral fluids and vital signs remained stable. The patient improved symptomatically with antibiotics. On hospital day two, his maintenance diuretics were restarted and patient was discharged home with close follow-up.

Discussion POCUS is an excellent tool to assist in the diagnosis and management of patients with shortness of breath. Its use is increasing in Internal Medicine, with support from multiple professional societies.^{1,2} The key to using and integrating POCUS effectively is thinking about it as one piece of the clinical picture—similar to a physical exam finding or lab test. Among patients presenting with acute dyspnea or a clinical suspicion for HF, greater than or equal to three B-lines in two bilateral lung zones was found to have a positive likelihood ratio (LR) of 12.38 and a negative LR of 0.06 (table 2).⁴ Our patient only had B lines in one lung zone and does not meet these criteria, thus the negative LR would apply, making it highly likely that our patient does not have cardiogenic pulmonary edema. POCUS has also been studied as a tool to detect pneumonia which also has significantly high LRs associated with the presence of subpleural consolidation or focal B-lines. (table 2).^{4,5} Taking each of these studies into consideration, we can feel confident that our patient did not have pulmonary edema and was appropriately treated for CAP. This case emphasizes a few

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Clinical Consideration	Pulmonary Edema	Pneumonia
POCUS Definition:	≥ 3 B-lines in bilateral lung zones	Subpleural consolidation and/or focal B-lines
Sensitivity (%)	94.1	92
Specificity (%)	92.4	94
Positive Likelihood Ratio	12.38	15.3
Negative Likelihood Ratio	0.06	0.09

(Summary and comparison of performance characteristics of bedside ultrasound findings for pulmonary edema and pneumonia [adults.] Adapted from Al Deeb, et al [2014], Orso, et al [2018].)

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important points. First, it is important to consider anticipated POCUS findings and how they may affect our diagnosis and management. In this case, we still rely on clinical judgment to treat with antibiotics regardless of our POCUS findings. While POCUS supported the diagnosis of pneumonia, its main clinical effect was the management decision to hold diuretics. Second, B-lines are not synonymous with cardiogenic pulmonary edema. Rather, they can represent an array of interstitial processes, requiring careful interpretation and integration of findings into the clinical picture. Finally, it's important to recognize the limitations of POCUS. Not all views will be perfect, and it's critical for the examiner to recognize when an exam is limited and he or she should not draw conclusions from those images. For example, in this case, three of the cardiac views were suboptimal and were not used as part

of the interpretation. In this case, POCUS did not clinch the diagnosis, but rather reinforced our clinical suspicion and helped guide management. POCUS is an emerging clinical tool with the capacity for a wide array of applications—highlighting its integral nature in the future education and practice of our specialty.

References

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