

"The Ultrasound Looked Fine": Point-of-Care Ultrasound and Patient Safety

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Case Objectives

- Understand the scope of a point-of-care cardiac ultrasound examination.
- Identify common terminology for a bedside ultrasound performed by a health care provider for patient care.
- Understand the difference between a limited and a complete cardiac ultrasound examination.
- Review the indications for an emergent echocardiogram performed by a cardiologist.

Case & Commentary—Part 1

A 51-year-old man with history of congestive heart failure (ejection fraction 35%–40%), end-stage renal disease on hemodialysis, and mechanical mitral valve replacement (on warfarin) presented with a 2-day history of shortness of breath. He also noted that since the night before, he was no longer able to hear his mitral valve click (which he could normally easily hear at bedtime).

On admission, his vital signs were normal and his lungs were clear. There were no cardiac murmurs or extra heart sounds, and he had no lower extremity edema. His chest radiograph showed no pulmonary edema, and his electrocardiogram showed no evidence of ischemia. The physician in the emergency department (ED) performed a bedside point-of-care cardiac ultrasound and interpreted it as having a stable low ejection fraction, some evidence of volume overload, and a mechanical mitral valve that was in place without regurgitation. The ED reported these findings to the hospitalist who admitted the patient with a presumed diagnosis of volume overload.

A point-of-care ultrasound (POCUS) is an ultrasound examination performed at the bedside using a portable ultrasound machine, typically used when a health care provider seeks to answer a focused question or set of questions. The process involves a few steps: the clinician performs the examination, interprets the images obtained, and integrates that interpretation into patient care. The use of the term

POCUS throughout this commentary is designed to maintain clarity and simplicity. Other terms, often used interchangeably, such as *emergency ultrasound*, *bedside ultrasound*, *focused ultrasound*, or *limited ultrasound* will not appear here. The scope of the examination distinguishes POCUS from a traditional comprehensive *consultative* ultrasound examination performed in the echocardiology laboratory or in the radiology department.⁽¹⁾ In the United States, most consultative examinations are performed by technologists (not clinicians) and are complete examinations of the organ or organs of interest, thus distinguishing them from the *limited scope* of a POCUS examination.

As a field, POCUS was initially led by emergency medicine, but now many medical specialties use POCUS for a wide spectrum of applications, including trauma, pregnancy, evaluation of the abdominal aorta, biliary tract, urinary tract, cardiothoracic system, and procedural applications.⁽¹⁾ Emergency medicine and critical care medicine specialists have authored most of the literature on POCUS. Moreover, since 2012, emergency medicine accreditation requires that residents achieve competency in POCUS.^(2,3)

The characteristics of POCUS (time efficient, portable, reproducible, and safe from ionizing radiation) have led it to be used in emergent, urgent, and nonemergent settings. A landmark resolution passed by the American Medical Association in 1999 (Resolution 802 and policy H-230.960) stated that ultrasound is "within the scope of practice of appropriately trained physicians" and that each specialty should decide the necessary training requirements for sonography competency.⁽⁴⁾ Consequently, departments utilizing POCUS are typically responsible for oversight and compliance with specialty-specific standards. Individual department POCUS leadership should be responsible for timely quality assurance review of POCUS examinations and for providing feedback to providers in accordance with the specialty-specific guidelines and credentialing policies.⁽⁵⁾

Substantial high-quality literature supports the use of POCUS for diagnosis. Most of the evidence has involved emergency medicine providers performing ultrasound in the ED. For cardiac ultrasound, emergency medicine providers can accurately make diagnoses (when compared to reference standards) in the evaluation of pericardial effusion, chamber size, left ventricular function, and thoracic aneurysm. When performed by trained providers, POCUS examinations are accurate and time efficient for many aspects of patient care including diagnosis, monitoring, and procedural guidance.⁽⁶⁻¹²⁾ For example, POCUS physicians are accurate in the evaluation and measurement of the abdominal aorta for aneurysm.⁽¹³⁾ Emergency physicians can evaluate women in the first trimester of pregnancy, confirm an intrauterine pregnancy, and facilitate a decreased length of stay in the ED.⁽¹⁴⁾ Emergency physicians can evaluate patients presenting with symptoms concerning for acute cholecystitis and facilitate a decreased length of stay when the examination is negative.⁽¹⁵⁾ When evaluated by physicians using the focused assessment of sonography in trauma, patients are taken to the operating room faster.⁽¹⁶⁾

The literature offers relatively few descriptions of typical errors or pitfalls in cardiac POCUS. In fact, the common error in POCUS actually is not using POCUS when indicated. From our experience, we have observed some common limitations and pitfalls. At first, it may be difficult to obtain images that are interpretable on cardiac POCUS due to the patient's acute presentation, the patient's body habitus, experience of the sonologist, or limitations of the machinery. Aspects of the patient's habitus that may present a challenge include (but are not limited to) obesity, abnormality of the bony thoracic cage, and a distended abdomen.^(17,18) Pathologic processes such as hyperinflated lungs, subcutaneous emphysema,

and pneumothorax will distort ultrasound images. Mistaken interpretations may occur if the orientation of the transducer with the orientation marker on the screen is reversed. Pleural fluid may be mistaken for pericardial fluid. Finally, blood, clotted blood, and pericardial fat may appear similarly echogenic on cardiac POCUS.⁽¹⁷⁾ In general, errors and pitfalls can occur with any acquired skill, with any procedure, and with any technology. For POCUS, novice sonographers may be less skilled in obtaining good ultrasound windows. High-quality ultrasound images are essential for accurate interpretation.

In the current case, the use of POCUS examination was appropriate to evaluate the ejection fraction (global left ventricular function). Volume overload would typically be determined after a POCUS evaluation of the heart, lungs, and inferior vena cava—not by a cardiac POCUS examination alone. A credentialed provider could comment upon visualization of the mitral valve; however, a POCUS cardiac examination does not extensively evaluate the valves as this requires more advanced skill. The hospitalist should not have considered an emergency department POCUS a complete examination, particularly with regard to the review of the mechanical valve. In this patient, one with a prosthetic heart valve stating he was short of breath and no longer hearing his mitral valve click, a complete echocardiogram was clearly indicated. Moreover, the physical examination findings confirmed a lack of valvular click. The emergency department POCUS was a reasonable first test, and its findings correctly reassured the clinicians that the patient was stable and that an emergent consultation and echocardiogram were not necessarily indicated. Reasons for ordering an emergent consultative echocardiogram include, but are not limited to, hemodynamic instability or concern for a structural abnormality such as a valve or a cardiac mass.

Case & Commentary—Part 2

On admission, the hospitalist's physical examination had the same findings as the one conducted by the ED provider. The hospitalist did not repeat a POCUS. Reassured by the report from the ED provider, the hospitalist also did not think a formal transthoracic echocardiogram was indicated—despite the complex cardiac history, the patient's report of not hearing the mitral valve click, and the fact that no murmur or extra heart sounds could be auscultated. Without another clear cause for the shortness of breath, the hospitalist was comfortable with the presumed diagnosis of volume overload, and the patient underwent hemodialysis that day with removal of 1.9 liters of fluid. He tolerated the procedure well, felt better, and requested to go home. He was discharged later that day.

Less than 12 hours later, the patient returned critically ill and in cardiogenic shock. An emergency formal transthoracic echocardiogram in the ED found a thrombosed mitral valve, leading to acute mitral stenosis and cardiogenic shock. He required a central line and vasopressors to maintain his blood pressure and underwent emergency mitral valve replacement. He survived the procedure but had an extended course in the intensive care unit. He was discharged to a skilled nursing facility one week later.

Review of the case concluded that the initial ED ultrasound should not have been used as an assessment of mitral valve function. A review of the ED POCUS showed evidence of the mitral valve thrombosis. However, the ED provider was not expected to have identified this finding, as assessment of valvular function is outside the scope of bedside point-of-care cardiac ultrasound. Given the clinical presentation,

the hospitalist should have ordered a formal transthoracic echocardiogram during the first admission to the hospital.

It is difficult to determine a single cause for this patient's adverse event; patient care errors are often multifactorial. The patient stated he was not hearing a click. Neither the emergency provider nor the hospitalist auscultated a mechanical sound. Yet, further investigation of the valve and its functioning was not pursued by specialty consultation or with a complete echocardiogram performed by the department of cardiology. Anchoring bias played a role in the decision to treat the patient for fluid overload—a diagnosis that should have been questioned given the findings of clear lungs, no peripheral edema, and a clear chest radiograph.

Verbal or cursory reports of the interpretation of a cardiac POCUS examination from one provider to another should be discouraged. "Phantom scanning" or a quick-look examination, in which a provider does not save (archive) images, performs the minimal criteria for a focused examination, and simply documents a procedure note in the medical record should also be discouraged. In general, all providers should ensure that a POCUS note is placed in the record, that the images are archived, and that images are viewable if patient care decision-making is based upon this examination.

In this case, the ultrasound report would state the indication for the examination, the technique, the findings, and the interpretation. Not only should the hospitalist have reviewed the findings and the interpretation; if qualified, he or she should have reviewed the images in an analogous way that an echocardiogram and a chest radiograph would be reviewed. If the hospitalist were not qualified to interpret the images, a reasonable option would be to have a cardiology consultant review them.[\(19\)](#)

Prosthetic valve thrombosis is a rare complication of a mechanical heart valve. It is more common for patients to have embolic events, with a nonobstructive thrombosis. The physical examination presentation can be variable; however, a disappearance of heart sounds or a new murmur should raise suspicion of prosthetic valve thrombosis. The diagnostic workup requires a transthoracic echocardiogram.[\(20\)](#)

Institutions can take specific concrete steps to ensure the use of POCUS is evidence-based, safe, and high-yield. One solution, which standardizes and raises awareness of the scope of POCUS, is the formation of a hospital or systemwide POCUS committee. Such a committee can write and implement guidelines to ensure effective POCUS utilization. Such a committee would support quality POCUS utilization across the range of clinical settings. System guidelines for POCUS would address all aspects of a program (e.g., leadership, training, competency, credentialing, quality assurance and improvement, documentation, archiving, workflow, equipment, and infrastructure issues relating to communication and information technology). Such a committee would work with departments to ensure proper documentation and image archiving. The committee could also ensure all clinical documentation complies with institutional, local, regional, and national standards.[\(5,21\)](#) Literature on the development of such guidelines is scarce, but one recent communication has described a systemwide clinical ultrasound program and its impact.[\(22\)](#)

Regarding education and training, the current national guidelines for competency are specialty specific. These guidelines describe specific goals and expectations for didactic learning (e.g., lectures) and experiential learning (e.g., practice with the ultrasound). The guidelines also set forth expectations regarding assessment of competency in POCUS. Currently, residency programs and clinical departments

can determine which combination of assessment methods best fits the program, learners, faculty, and curriculum. These methods may include but are not limited to a question bank, a quality assurance process, direct observation, observed structured clinical examinations, and simulation cases.[\(5,23\)](#)

While many issues led to the adverse event in this case, an overreliance on the reported POCUS findings clearly played a role. As with other diagnostic tests (e.g., radiographs, electrocardiograms, etc.), providers need to recognize when the findings of the test do not fit the clinical signs and symptoms, and when the clinical situation requires a different examination. Providers should correlate POCUS interpretations with other elements of the clinical evaluation to exclude common etiologies and accurately identify the diagnosis. Substantial evidence supports the accuracy of POCUS, and institutions should take steps to ensure its safe and evidence-based use.

Take-Home Points

- A point-of-care ultrasound examination enables the provider to answer a focused question or set of questions in the diagnostic, therapeutic, or procedural care of a patient.
- A point-of-care ultrasound performed for patient care, and on which clinical decisions are made, requires archived images and health care record documentation.
- A point-of-care ultrasound cardiac documentation note for the patient chart would state the indication for the examination, the scope of anatomy evaluation, the findings, and the health care provider interpretation of the findings.
- Understanding the strengths and limitations of the point-of-care ultrasound examination in the context of the clinical evaluation is important.

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