

New Views: Handheld Ultrasound at the Bedside

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The events recounted here are true; the name Mrs. Michaels is fictional to protect the privacy of the patient.

It didn't add up. She was in shock but denied any symptoms that might suggest the cause. No fever, no chest pain, no dyspnea, no belly pain . . . nothing.

Three hours earlier, Mrs. Michaels had abruptly lost consciousness while seated at her breakfast table. She was tachycardic when the emergency medical technicians pushed her through the emergency room doors. Her daughter reiterated to the nurses that the day had been no different from any other in the life of her 80-year-old mother. Now, despite 2 liters of intravenous fluid and a vasopressor, her blood pressure continued to fall. That's when our intensive care unit (ICU) team was called. Was this a ruptured aortic aneurysm, cardiac tamponade, a pulmonary embolism, or perhaps sepsis? We had to find out.

When I met Mrs. Michaels, I began my medical resident's ritual of obtaining her history and performing a physical examination. After confirming her blood pressure, I listened to her heart and lung sounds, pushed on her belly, and examined her neck veins and extremities. Besides tachycardia and an elevated jugular venous pressure, the etiology of her shock was still uncertain.

Then I broke from tradition. I performed a focused cardiac ultrasound with my own handheld device. Crowding out the view of her left ventricle was a dilated bag of blood. Was that the aorta I saw? I rotated the probe and changed the depth. Was that the right ventricle?

The opportunity to rush Mrs. Michaels to the CT scanner en route to the ICU vanished as her blood pressure continued to fall. I called my attending and reported my findings. Fluids and vasopressors weren't enough. We had to quickly change our perspective.

During my medical residency training, I have used a handheld ultrasound to augment my bedside physical examination. I was fortunate to participate in research teaching point-of-care ultrasound to novices while in medical school.¹ After learning the basic techniques, I

bought my own handheld ultrasound using money saved from gifts and a graduation scholarship. I brought it with me to residency, carrying the anticipation and excitement of learning and sharing a unique perspective at the bedside.

For most of my intern year, I kept the ultrasound stored in my locker, finding little time to use it. As a junior resident, I carried the ultrasound in a small messenger bag, using it when the diagnosis was in question. Over time, the bag vanished and I kept the ultrasound in my pocket across from my stethoscope, limiting the steps needed to examine patients with it. Now, as a senior resident, using the ultrasound has become an indispensable ritual in my approach to examining and diagnosing patients.

While teaching ultrasound skills is becoming more popular in medical school and residency training programs, carrying a personal ultrasound is still unusual.²⁻⁴ Teaching point-of-care ultrasound has clear benefits, namely improved accuracy of the traditional physical examination.⁵⁻⁸ But I often encountered arguments against its utility, including the absence of a proven benefit to patient mortality and morbidity, concerns about unnecessary testing prompted by incidental findings, and the risk of bacterial transmission by the probe itself.^{9,10} Though important, these concerns mostly distracted from the opportunity to revolutionize the way we see and examine patients, and run contrary to my experience.

At the bedside, I practiced using the ultrasound to assess volume status, search for depressed ventricular function, and find effusions.^{11,12} My skills improved while collaborating with my co-residents and teaching patients about their health and diseases by showing them directly. Despite the advantages of the handheld ultrasound, I often returned to my stethoscope to confirm what I heard or felt with what I saw. The 2 complement each other, each tool improving the other. Using the ultrasound allowed me to revise a provisional diagnosis based on the images, guide diagnostic testing, and safeguard against diagnostic anchoring.

By the time Mrs. Michaels arrived in the ICU, her blood pressure was tenuous despite repeated fluid boluses and 2 vasopressors. As the nurses transferred her, I took out my ultrasound and reimaged the parasternal long axis view with my attending. Tilting the probe, we identified the landmarks and recognized that we were looking at a dilated right ventricle. This view confirmed a massive pulmonary embolism and obstructive shock in the absence of classic

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DOI: <http://dx.doi.org/10.4300/JGME-D-14-00369.1>

signs and symptoms. Excited to have uncovered the diagnosis, we had a quick discussion with the patient and her daughter. We agreed to proceed with thrombolysis, and the patient responded. Six hours later, we confirmed our findings with a formal transthoracic echocardiogram and successfully weaned her off both vasopressors. Mrs. Michaels showed marked improvement, so we transferred her to the floor the next day.

Across the country, the use of handheld ultrasound continues to grow as ultrasound curricula are introduced into medical school and residency training with positive results. Learners report enthusiastic engagement and demonstrate improved speed and accuracy in physical examination, for example, identifying left ventricular systolic dysfunction.^{3–5,13}

Barriers exist to teaching handheld ultrasound examination in training programs, namely time and money. But both are reasonable investments. The time required to grasp the basic principles of the ultrasound examination is modest, and most novices acquire ultrasound skills quickly.^{1,5,13} I felt comfortable with the ultrasound after examining only a few patients with it. Residency programs could incorporate handheld ultrasound training with minimal program time. Monthly hands-on sessions (such as during a regular conference) could be supplemented with available online educational resources.^{3,14,15}

With respect to cost, a handheld ultrasound sells for \$7,000 to \$9,000. As I learned firsthand, the investment continues to pay dividends by enhancing the physical examination and critical thinking regarding patients by visualizing the disease process in question. By purchasing a communal ultrasound to use in high-impact areas, such as the ICU or the emergency department, training programs would ensure that residents gain real-time exposure and build their skills. Remote coaching is possible in addition to bedside teaching.¹

Although training programs will likely face other challenges, starting a handheld ultrasound curriculum is within reach. Consensus statements outline standard examinations and the necessary tools to help guide implementation.^{12,16} Online resources, including the Association of American Medical Colleges' MedEd Portal and the Society of Ultrasound in Medical Education, provide blueprints with sample handheld ultrasound curricula and learning modules.^{15,17}

Handheld ultrasound technology is available and maturing, enthusiasm is growing, and, as I learned, every point-of-care ultrasound examination represents an opportunity to see patients from a new view. It is time for residency program leaders to embrace ultrasound technology, formalize training, and encourage online learning. Training the next generation of physicians with handheld ultrasound technology promises to reinvigorate and improve patient care by directing our focus back to where we can diagnose best—the bedside.

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