

# Ultrasound Protocol Use in the Evaluation of an Unstable Patient

Danielle Hallett, MD<sup>a</sup>, Parisa P. Javedani, MD<sup>a</sup>,  
Jarrod Mosier, MD<sup>a,b,\*</sup>

## KEYWORDS

• Ultrasound • Hemodynamically unstable • Resuscitation • Protocol • Emergency • Shock

## KEY POINTS

- Bedside ultrasound has been shown to facilitate faster and more accurate diagnoses in unstable patients in the emergency department.
- Rapid ultrasound examination of the unstable patient allows physicians to detect reversible causes, such as pericardial tamponade, decreased cardiac contractility, right heart strain, hypovolemia, pleural effusion, pulmonary edema, pneumothorax, and abdominal aortic aneurysm, with reasonable accuracy.
- The ultrasound examination can be repeated frequently to determine a patient's response to therapy.
- In patients with pulseless electrical activity or asystole, lack of cardiac motion on echocardiography correlates with a poor likelihood of survival.
- Many ultrasound protocols have been proposed for the evaluation of the unstable patient but few have been validated.

 Videos related to pertinent ultrasound findings accompany this article at <http://www.ultrasound.theclinics.com/>

## CASE 1

A 63-year-old woman with a history of atrial fibrillation, asthma, rheumatoid arthritis, and hypertension arrives in the emergency department (ED) via ambulance for shortness of breath and cough. On initial evaluation, her heart rate is 120 beats per minute (bpm), blood pressure is 87/50 mm Hg, temperature is 38.4°C, respiratory rate is 28 breaths per minute, and oxygen saturation is 85% on 15 liters per minute (lpm) via a non-rebreather mask. The patient's heart and lung examination reveals crackles throughout all lung

fields. Her electrocardiogram shows ST elevation in leads aVR and V<sub>1</sub>, with diffuse ST depression in the other leads.

## Discussion of the Problem/Introduction

This case describes a common diagnostic and therapeutic dilemma when treating a patient in the ED with undifferentiated hypotension. An immune-suppressed middle-aged woman presents febrile, hypotensive, and tachycardic with shortness of breath and electrocardiographic findings concerning for myocardial ischemia. The

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<sup>a</sup> Department of Emergency Medicine, University of Arizona, 1609 North Warren Avenue, FOB 122C, Tucson, AZ 85719, USA; <sup>b</sup> Section of Pulmonary, Critical Care, Allergy and Sleep, Department of Medicine, University of Arizona, 1609 North Warren Avenue, Room 122C, PO Box 245057, Tucson, AZ 85724-5057, USA

\* Corresponding author. Department of Emergency Medicine, University of Arizona, 1609 North Warren, FOB 122C, Tucson, AZ 85719.

E-mail address: [jmosier@aemrc.arizona.edu](mailto:jmosier@aemrc.arizona.edu)

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physician must determine whether this is severe sepsis requiring fluid resuscitation or a cardiogenic or obstructive cause of shock, in which fluid resuscitation might be detrimental. In this case, a bedside ultrasound is performed and the echocardiogram shows an enlarged right ventricle with septal flattening (Video 1). The inferior vena cava (IVC) measures 2.2 cm and has no respiratory variation (Fig. 1).

All findings were consistent with elevated right heart pressure and suspected pulmonary embolism. The emergency physician evaluated the veins of the lower extremities and found a thrombus in the popliteal vein (Video 2). Treatment with tissue plasminogen activator was given in the ED and the patient was admitted to the intensive care unit (ICU).

When critically ill patients arrive in the ED, the initial evaluation can be limited by a variety of factors, leaving practitioners to sift through the vast possibilities for the patient's deteriorating condition. Traditionally, physicians depend on physical examination to guide diagnosis and initiate resuscitation in these critical first minutes. The scarcity of information can lead to inaccurate diagnosis or unnecessary and potentially harmful therapeutic interventions, which could be detrimental to the patient's care. Using the case described as an example, administering intravenous fluids to a patient believed to be in septic shock could cause further decompensation if the patient were actually experiencing obstructive shock from a pulmonary embolism.

Point-of-care ultrasound provides the ability to quickly narrow the differential diagnosis and guide

appropriate resuscitation of critically ill patients. Early ultrasound evaluation of critically ill patients has been shown to increase the accuracy of and decrease the time to diagnosis, and change the disposition of many patients.<sup>1-3</sup>

In the evaluation of unstable patients, ultrasound has several advantages. First, it is performed at the bedside, allowing tenuous patients to remain where they can be aggressively treated and carefully monitored. Second, it is the only readily available modality that allows real-time dynamic imaging to occur at the same time as an intervention or diagnostic maneuver, such as passive leg raise. Finally, the examination can be repeated frequently to assess the patient's response to therapies without concern for additional radiation.

Several ultrasound protocols have been developed for the evaluation and resuscitation of unstable patients, both medical and traumatic.<sup>3-10</sup> Few of these protocols have been studied or validated in their entirety, but good evidence supports the individual components within these protocols. Each protocol is unique in the views obtained and level of complexity of image interpretation. Despite that, all protocols evaluate some combination of the following structures: heart, IVC, aorta, abdomen, pleura, and lower extremity veins. The following is a review of how each of these structures is evaluated with ultrasound and how the evaluation guides resuscitation of an unstable patient. This review will describe and compare ultrasound use and protocols in the undifferentiated unstable patient. Table 1 describes the common ultrasound findings in the shock state.

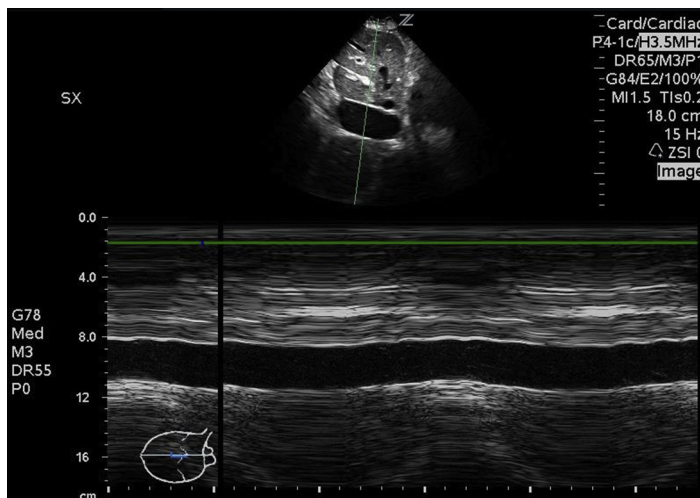


Fig. 1. An M-mode image through the inferior vena cava showing a dilated, noncollapsible inferior vena cava.

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