



PHILIPS

Ultrasound

Quick guide – RUSH restructured

Focused ultrasound evaluation of undifferentiated non-traumatic hypotension

Michael B. Stone, MD

Legacy Emanuel Medical Center
Portland, OR

The more you see, the more you can do

Focused ultrasound can play a valuable role in the assessment of hemodynamically unstable patients. Multiple authors have previously described its application in this context, most notably with the Rapid Ultrasound for Shock and Hypotension (RUSH) exam,^{1,2} the Abdominal and Cardiac Evaluation with Sonography in Shock (ACES) exam,³ and the Undifferentiated Hypotension Protocol (UHP).⁴ While there are considerable differences among these descriptions, all describe the application of focused ultrasound in patients with three key features: unstable, undifferentiated and non-traumatic.

Focused ultrasound evaluation of undifferentiated non-traumatic hypotension

A brief review

Unstable, undifferentiated and non-traumatic

“Unstable” in this context refers to shock, which is defined by hypotension associated with clinical features that suggest poor tissue perfusion (e.g., diaphoresis, altered mental status, dyspnea).

“Undifferentiated” serves to separate this patient population from non-traumatic unstable patients with an obvious diagnosis; for example, massive gastrointestinal hemorrhage, anaphylaxis or known medication overdose.

“Non-traumatic” separates these patients from those whose shock can be attributed to blunt and/or penetrating trauma, and in whom hemorrhagic shock is the etiology until proven otherwise.

Focused ultrasound is intended to help the clinician identify an etiology of shock when there is no obvious cause after the initial history and physical examination have been performed.

Our best understanding of the epidemiology of this population of patients with undifferentiated non-traumatic hypotension comes from a prospective trial conducted in the emergency department⁵, in which 77% of patients were ultimately diagnosed with an infectious and/or distributive cause of shock.

As a result, the following evidence-based approach assumes that the underlying pathologic state is infectious/distributive and focuses early on empiric treatment for infectious/distributive shock while simultaneously using point-of-care ultrasound to quickly identify an obstructive or cardiogenic process, as these require a significant change in treatment (algorithm).



Obstructive shock – cardiac/IVC

Hemorrhagic shock – aorta/FAST

Septic shock – renal/biliary

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Obstructive shock evaluation – cardiac/IVC

Standard cardiac views should be obtained first, in order to identify features that suggest an obstructive or cardiogenic etiology of shock.

- Evaluate for the presence of a pericardial effusion, particularly large effusions and/or effusions with associated right-sided chamber collapse and/or inferior vena cava plethora, as these are more suggestive of cardiac tamponade (Figure 1).
- Evaluate for the presence of right ventricular (RV) enlargement, paradoxical septal motion and/or right-sided intracardiac thrombus, as this may suggest or confirm, respectively, the diagnosis of pulmonary embolism (Figure 2).

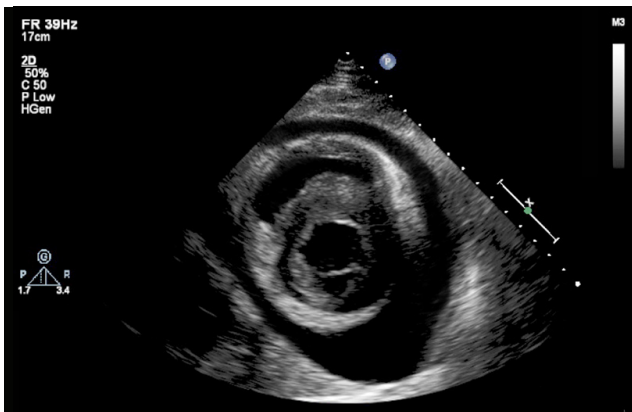


Figure 1 Large pericardial effusion



Figure 2 RV strain – note the D-sign

- Unstable patients with cardiac tamponade will require emergent pericardiocentesis.
- If there are signs of RV strain, a focused assessment of lower extremity veins may be performed as the identification of a deep venous thrombosis (DVT) can confirm the diagnosis of venous thromboembolism (VTE) at the bedside.
- Unstable patients with pulmonary embolism should be treated according to regional/institutional guidelines, with systemic thrombolysis, catheter-directed thrombolysis, thrombectomy and/or ECMO (extracorporeal membrane oxygenation).

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Focused ultrasound evaluation of undifferentiated non-traumatic hypotension

- Evaluate for the presence of left ventricular systolic failure as this will lead to initiation of inotropic support as opposed to fluid resuscitation (Figure 3).

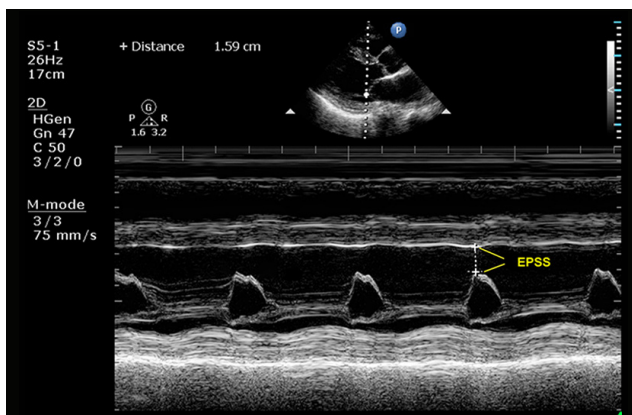


Figure 3 Abnormal EPSS suggesting LV systolic dysfunction

- Clinicians with advanced point-of-care ultrasound skills may also consider evaluating for significant valvular disease (Figure 4).

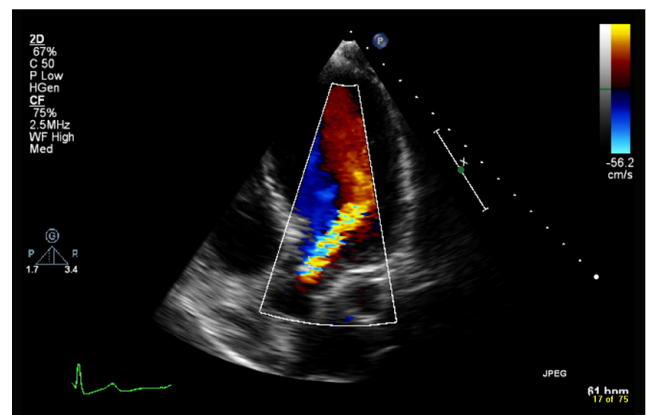


Figure 4 Significant aortic insufficiency noted on color flow Doppler

- Evaluate the size and respiratory variability of the inferior vena cava (IVC).
- In the absence of significant IVC dilatation and reduced respiratory variability, the likelihood of obstructive shock is very low (Figure 5).

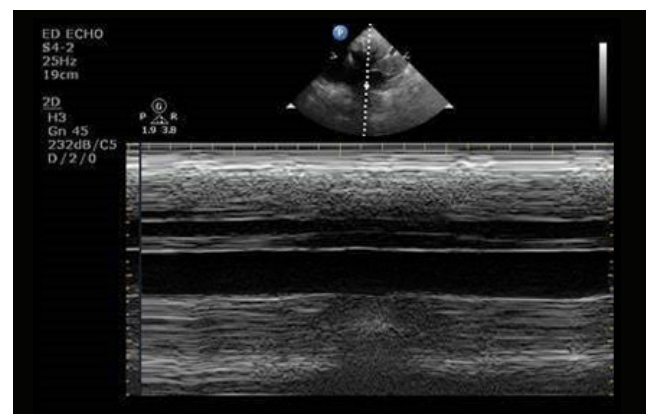


Figure 5 Plethoric IVC without respiratory variability

Focused ultrasound evaluation of undifferentiated non-traumatic hypotension

Hemorrhagic shock evaluation – aorta/FAST

- Evaluate the abdominal aorta throughout its course, from the diaphragm to the bifurcation into the common iliac arteries.
- The presence of an abdominal aortic aneurysm (AAA), particularly an aneurysm greater than 4.5 centimeters in diameter, should lead clinicians to consider a ruptured abdominal aortic aneurysm and to initiate treatment and consultation (Figure 6).
- Evaluate the peritoneum for free fluid in the right upper quadrant, left upper quadrant and pelvis, as this may suggest occult intra-abdominal hemorrhage, a ruptured hollow viscus or the presence of an abdominal infectious process (Figure 7).



Figure 6 Large AAA with mural thrombus

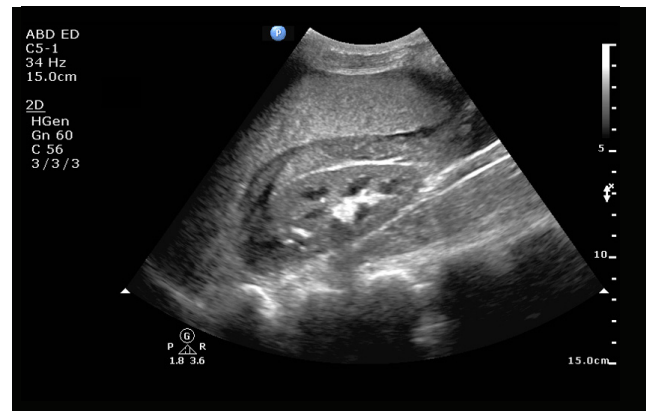


Figure 7 Positive RUQ with internal echoes representing acute hemorrhage with associated clot

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[Click here](#) to view the **FAST exam quick guide**

Focused ultrasound evaluation of undifferentiated non-traumatic hypotension

Septic shock evaluation – renal/biliary

- Evaluate the kidneys for hydronephrosis.
- In patients with suspected septic shock and a proven or suspected urinary infection, urgent decompression of renal obstruction (typically via percutaneous nephrostomy) is indicated in order to achieve source control (Figure 8).
- Evaluate the gallbladder for signs of cholecystitis.
- In patients with suspected septic shock and sonographic signs of cholecystitis, urgent biliary decompression (via cholecystostomy) is indicated in order to achieve source control (Figure 9).

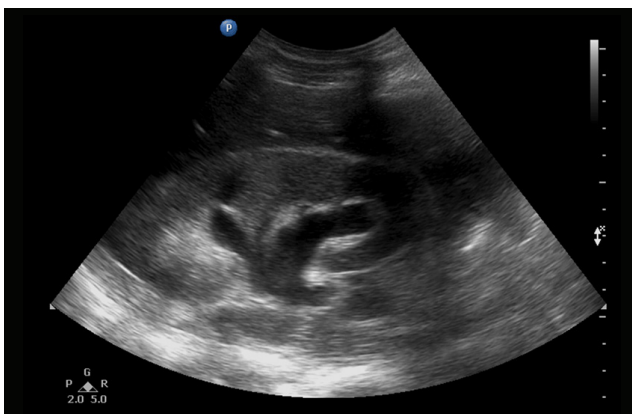


Figure 9 Gallbladder with evidence of cholecystitis

[Click here to view the Focused renal quick guide](#)

[Click here to view the Focused ultrasound of the gallbladder tutorial](#)

References

- 1 Weingart, S, et al. The RUSH Exam: Rapid Ultrasound for Shock and Hypotension. <https://emcrit.org/rush-exam/>
- 2 Perera P, Mailhot T, Riley D, et al. The RUSH exam: Rapid Ultrasound in SHock in the evaluation of the critically ill. *Emerg Med Clin North Am.* 2010 Feb;28(1):29–56.
- 3 Atkinson PR1, McAuley DJ, Kendall RJ, et al. Abdominal and Cardiac Evaluation with Sonography in Shock (ACES): an approach by emergency physicians for the use of ultrasound in patients with undifferentiated hypotension. *Emerg Med J.* 2009 Feb;26(2):87–91.
- 4 Rose JS, Bair AE, Mandavia D, et al. The UHP ultrasound protocol: A novel ultrasound approach to the empiric evaluation of the undifferentiated hypotensive patient. *Am J Emerg Med.* 2001;19:299–302.
- 5 Jones AE, Tayal VS, Sullivan DM, et al. Randomized, controlled trial of immediate versus delayed goal-directed ultrasound to identify the cause of nontraumatic hypotension in emergency department patients. *Crit Care Med.* 2004;32:1703–1708.

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Perform history and physical.

If unstable, undifferentiated, non-traumatic hypotension:

- **Initiate** IV crystalloid resuscitation
- **Begin** ultrasound assessment*
- **Consider** early antibiotic therapy

*If a diagnosis is established at any point in the evaluation, further progression down the algorithm may no longer be necessary.

? Obstructive shock – cardiac/IVC

Pericardial effusion with suspicion for cardiac tamponade?

↓ No

Right ventricular strain?

↓ No

Left ventricular systolic failure or left-sided valvulopathy?

↓ No

Yes →

Continue volume resuscitation and prepare for pericardiocentesis.

Yes →

Consider focused DVT assessment to confirm VTE. Slow volume resuscitation. Consider tPA, thrombectomy, ECMO.

Yes →

Consider halting fluids, initiate vasopressors if indicated, early cardiology/ cardiothoracic surgery consultation.

? Hemorrhagic shock – aorta/FAST

Abdominal aortic aneurysm?

↓ No

Free intraperitoneal fluid?

↓ No

Yes →

Type and cross for blood products, initiate transfusion if clinically indicated. Consult vascular surgery.

Yes →

Type and cross for blood products, initiate transfusion if clinically indicated. Consult general surgery.

? Septic shock – renal/biliary

Unilateral hydronephrosis suggestive of obstructive uropathy?

↓ No

Cholecystitis?

Yes →

Tailor antibiotic therapy appropriately and consult urology and/or interventional radiology.

Yes →

Tailor antibiotic therapy appropriately and consult surgery/interventional radiology.

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For information about **Philips Sparq ultrasound system** go to www.philips.com/sparq

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