>>EMERGENCY ULTRASOUND

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Rapid Ultrasound in SHock: The RUSH Protocol

This month, the case of a dialysis patient presenting in shock to the ED demonstrates the value of echocardiography as part of the RUSH protocol.

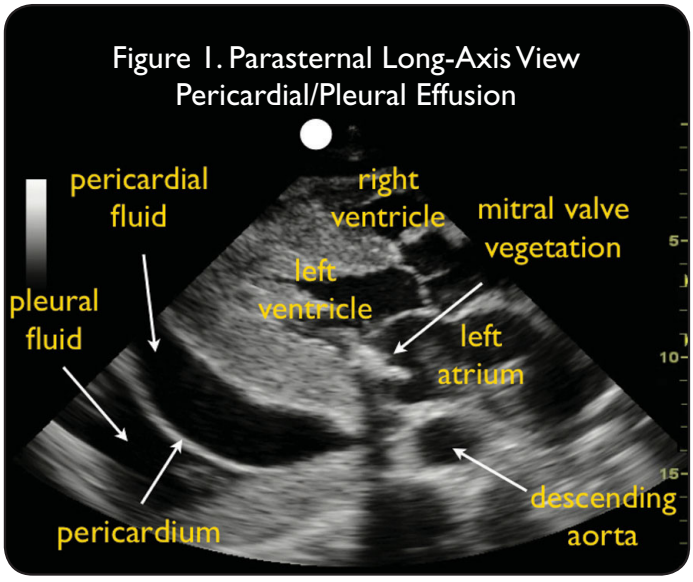

Figure 1. Parasternal Long-Axis View Pericardial/Pleural Effusion

CASE

A 52-year-old man presents to the ED with acute shortness of breath and weakness that have developed over the last day. He has a history of end-stage renal failure and currently receives hemodialysis through a right subclavian catheter three times a week. His last dialysis was yesterday. On evaluation, the patient appears acutely ill with rapid, shallow respirations timed at 36 per minute. His blood pressure is 86/60 mm Hg and his heart rate is 110 bpm. A room air pulse oximetry reading shows hypoxia at 86%, with improvement to 92% on 100% oxygen by face mask. His rectal temperature is 38°C. Rales and rhonchi are present on auscultation.

The patient's respiratory status rapidly deteriorates during his initial few minutes in the ED, and he is intubated using a swift sequence protocol. As you consider the differential diagnosis for this patient's rapid decompensation, you are aware that there are myriad possibilities and it is not clear how best to proceed. Using bedside ultrasound, you begin with a parasternal long-axis view of the heart: step 1 of the RUSH protocol (Figure 1). The patient is noted to have a large pericardial effusion as well as a left pleural effusion. Close inspection of the location of the descending aorta and posterior pericardial reflection allows the physician to identify the fluid as pericardial or pleural. This can occasionally be difficult, but you determine that this patient has fluid in both locations. Furthermore, the patient's left ventricle is noted to be contracting vigorously, with a large percentage change in the inward motion of the endocardial walls from diastole to systole.

Based on the presence of both pericardial and pleural fluid, it appears this patient is in heart failure. However, the vigorous left ventricular contractility rules out simple systolic failure due to hypocontraction of the left ventricle. As you look closer at the cardiac anatomy, you note a calcified structure on the posterior mitral valve. The structure appears very dense, with posterior acoustic shadowing indicating the inability of ultrasound waves to permeate the structure (as would also occur with a gallstone). Could this be valve vegetation, leading to acute mitral regurgitation and heart failure? You call for a stat cardiology

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"Emergency Ultrasound" presents clinical cases involving the diagnostic use of bedside ultrasound in the emergency department. Cases can be explored in more detail on the Web in the SoundBytes section of CMEDownload.com, which can be accessed directly at www.sound-bytes.tv. Instructional videos detailing the components of the RUSH exam are available for download.

Rapid Ultrasound in SHock: The RUSH Protocol

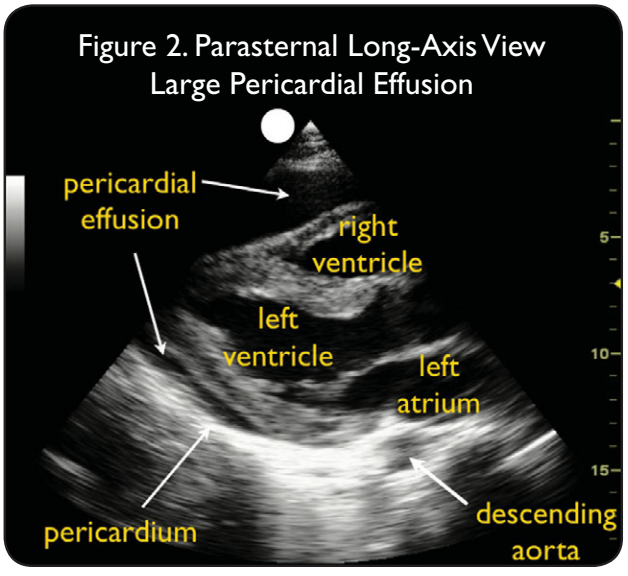

Figure 2. Parasternal Long-Axis View
Large Pericardial Effusion

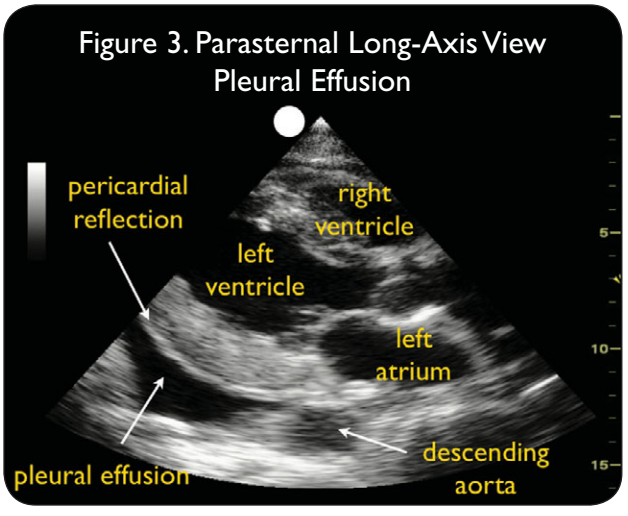

Figure 3. Parasternal Long-Axis View
Pleural Effusion

consult. The cardiology fellow agrees that the mitral valve structure is suggestive of vegetation. He calls for a cardiothoracic surgery consult; the surgeon agrees with the diagnosis of acute bacterial endocarditis leading to the acute heart failure. The patient is taken to surgery to excise and replace the valve. The pathology shows *Staphylococcus aureus* in the vegetation, traced back to the dialysis catheter, which apparently was the source of the infection. The patient recovers well after surgery and walks out of the hospital a week later.

DISCUSSION

While this case is complex, it illustrates how the RUSH protocol allows quick assessment of the "pump" and may give crucial diagnostic clues. The first goal of the "pump" assessment is to look for a pericardial effusion. As demonstrated in this patient, pericardial effusions are well seen from the standard cardiac views. From the parasternal view, it is important to differentiate pericardial fluid from pleural fluid. As mentioned earlier, the location of the descending aorta and the posterior pericardial reflection is key to this determination. Figure 2 shows a large pericardial effusion in a patient with a recent heart transplant. Note the fluid anterior to the posterior pericardial reflection, located within the pericardial space. Figure 3 shows a large pleural effusion in a patient with heart failure. Note the fluid location behind the posterior pericardial reflection, outside the pericardial space and within the pleural space. The use of RUSH imaging in our case patient demonstrates the appearance of fluid when it is present in both the pericardial and the left pleural cavity.

>> Look for upcoming segments of "Emergency Ultrasound," with additional case studies illustrating the value of the RUSH protocol in evaluating the critically ill patient.

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