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ULTRASOUND EDUCATION

A Guide to Point of Care Ultrasound Examination of a Pericardial Effusion

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LEARNING OBJECTIVES

1. Learn the technique for cardiac point of care ultrasound.
2. Identify and interpret the cardiac ultrasound findings consistent with pericardial effusion.
3. Identify and interpret the cardiac ultrasound findings consistent with cardiac tamponade.

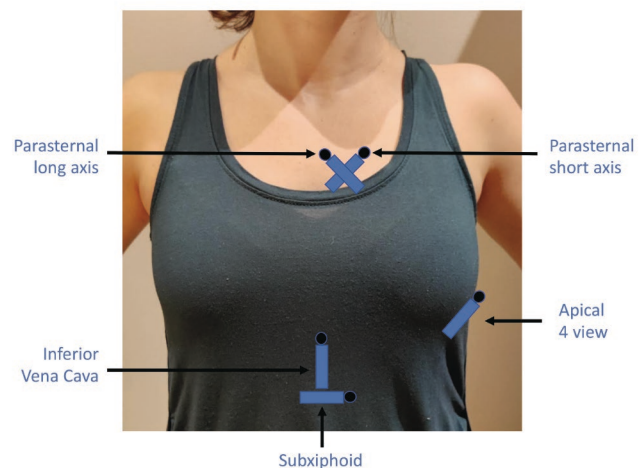
INTRODUCTION

A patient presents with pleuritic chest pain, dyspnea, and a recent viral illness. They have no prior cardiac or pulmonary history. Their X-ray on admission demonstrates no pulmonary findings and an enlarged cardiac silhouette, and their EKG is low voltage with electrical alternans. Ultrasound is an effective modality for identifying pericardial effusion and cardiac tamponade while at the same time evaluating for other causes, such as heart failure. Often patients with symptomatic pericardial effusion present with non-specific symptoms. While a "formal" transthoracic echocardiogram remains the gold standard for diagnosis, a bedside point of care ultrasound (POCUS) cardiac evaluation can significantly decrease the time to diagnosis and trigger an order for an urgent "formal" echocardiogram.¹ A retrospective study by Hanson and Chan in 2021 found that POCUS led to an expedited average time to diagnosis of 5.9 hours compared to >12 hours with other imaging. Those with a symptomatic pericardial effusion identified by POCUS had a significantly decreased time to treatment; time to pericardiocentesis of 28.1 hours compared to > 48 hours with other diagnostic modalities.²

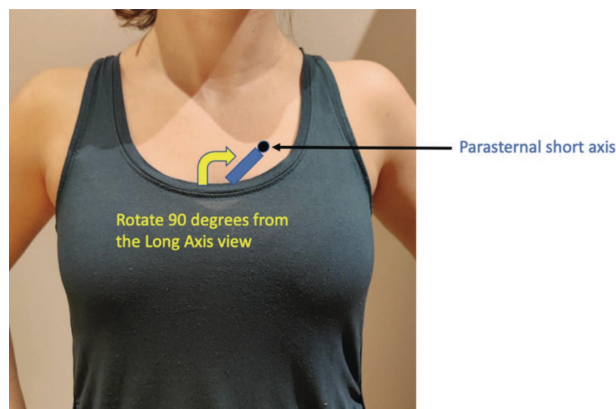
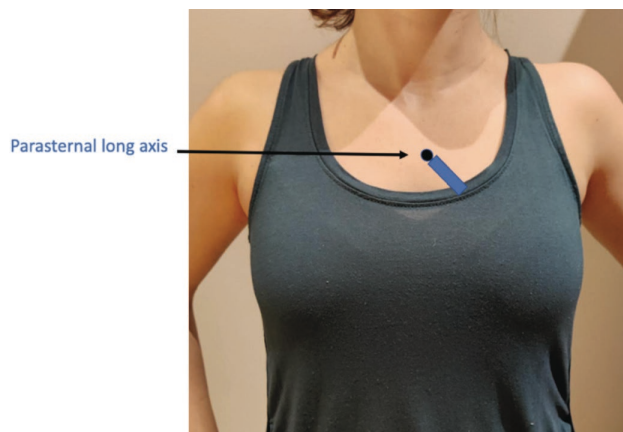
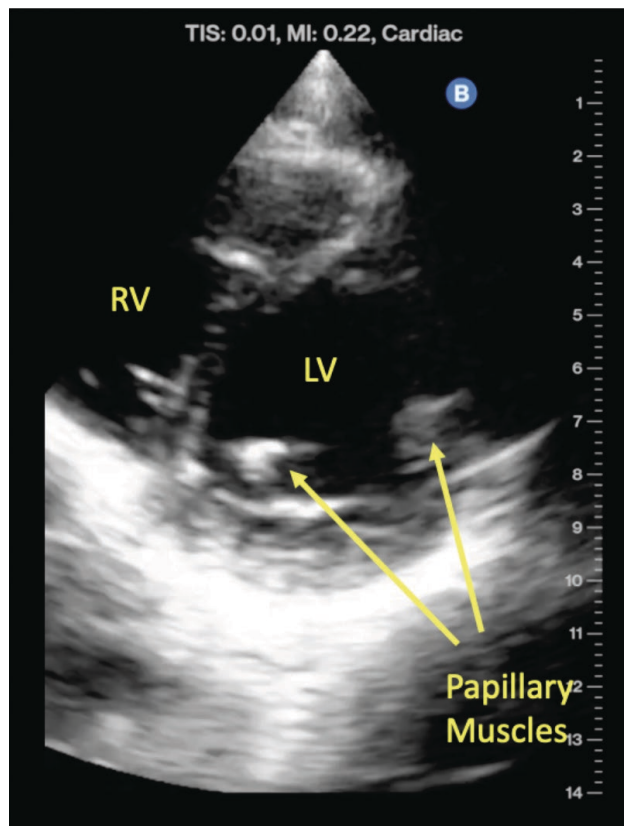
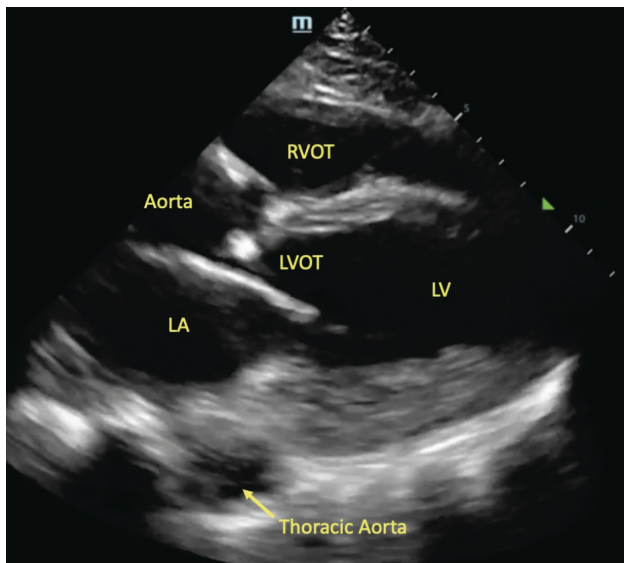
The POCUS cardiac exam can be further used to monitor the patient's response to therapy and identify a change, such as cardiac tamponade.³

TECHNIQUE

The Cardiac POCUS includes four views plus an IVC exam.

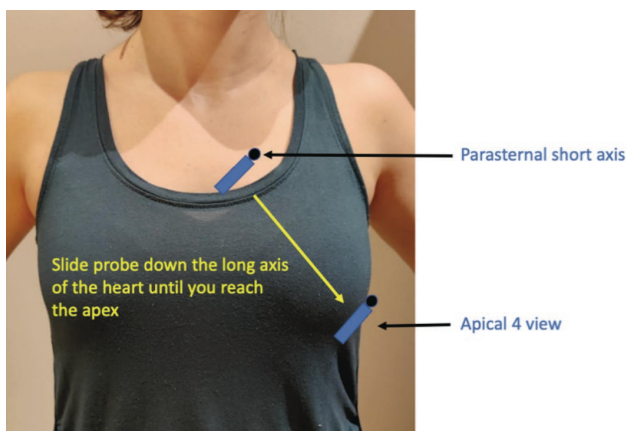
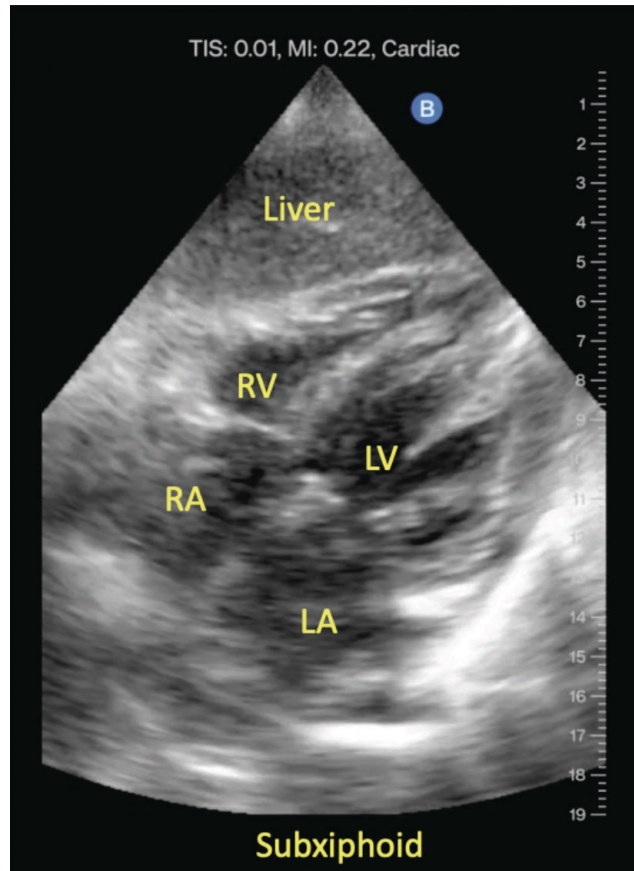
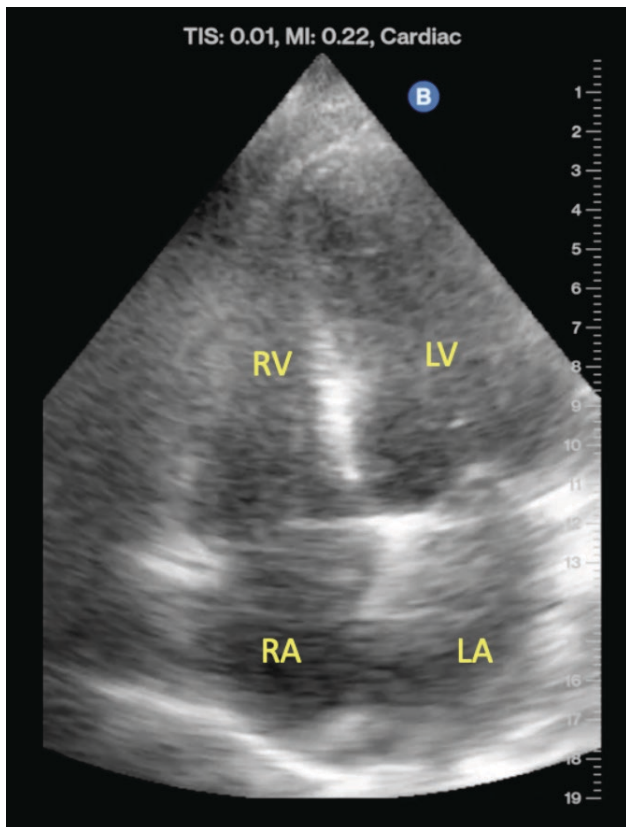


1. The parasternal long axis (PLAX) is obtained at the second intercostal to the left of the sternum, with the probe indicator directed at the patient's right shoulder.
 - a. The most anterior chamber is the right ventricle (RV) and right ventricular outflow tract (RVOT).
 - b. Deep to the RV is the left ventricle (LV). The left ventricular outflow tract (LVOT) leads to the aortic valve and aorta. The left atrium (LA) and mitral valve lead into the left ventricle.
 - c. The deepest structure identified is the thoracic aorta.
 - d. TIP: set your depth to the thoracic aorta.
 - e. TIP: the RVOT, aorta, and left atrium should be 1:1:1 in size. If one of those structures is significantly different, it may suggest that you are off-axis or that there is abnormal pathology.
2. The parasternal short axis (PSAX) is obtained at the same position as the PLAX but with a 90-degree rotation of the probe indicator towards the patient's left shoulder.
 - a. The ideal view will be at the level of the papillary muscles. The papillary muscles should be equal in size, which indicates that you are on the appropriate axis.

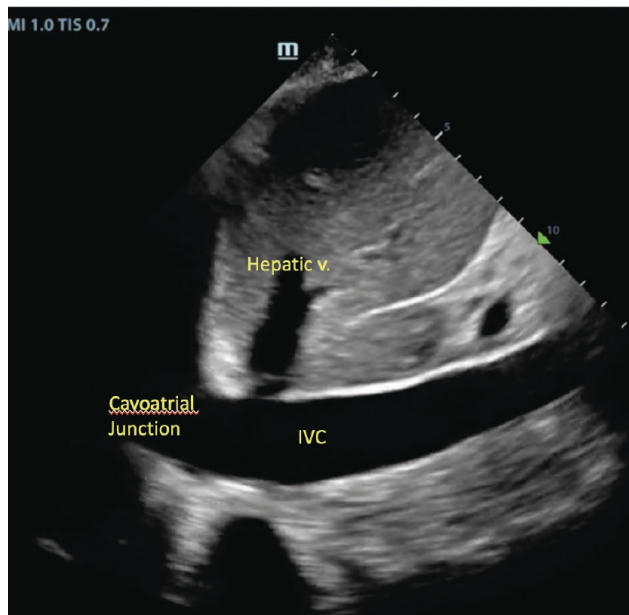


3. The apical 4-chamber (A4C) is obtained at the apex of the heart with the indicator pointed in the same axis as the PSAX.
 - a. After obtaining the PSAX, slide the probe down the length of the heart, and when you reach the apex, tilt the probe so that it is pointing up the long axis of the heart.
 - b. A 5-chamber view can be obtained by fanning your probe and capturing the aortic valve and LV outflow tract.

4. The subxiphoid view (SXI) is obtained by imaging from under the sternum with the probe held horizontally and the probe indicator directed to the patient's left.

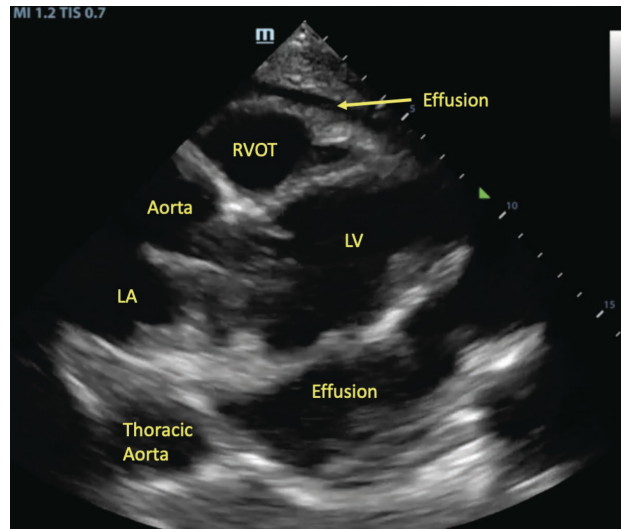


- The Inferior vena cava (IVC) view is obtained by first identifying the right atrium on the subxiphoid view, then rotating the probe 90 degrees so that the probe indicator is directed caudally.

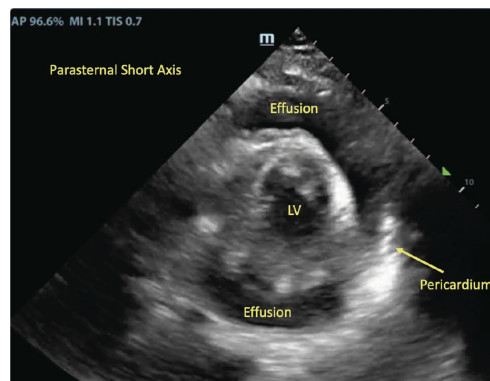
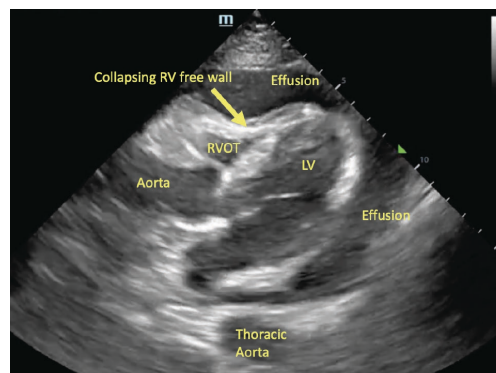


Findings Consistent with Pericardial effusion

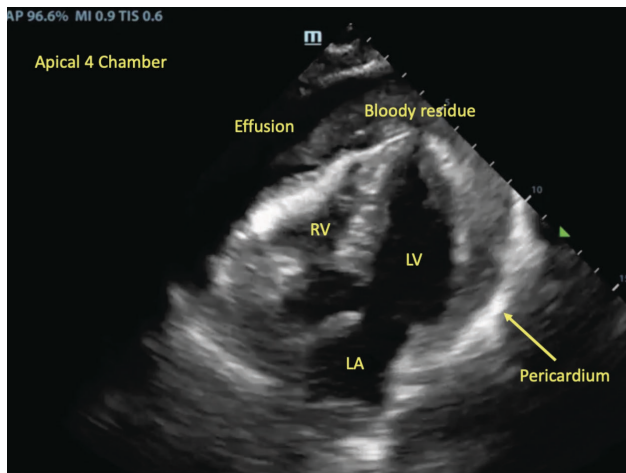
- Fluid around the heart on the parasternal long axis, which is visualized as an anechoic stripe surrounding the heart.



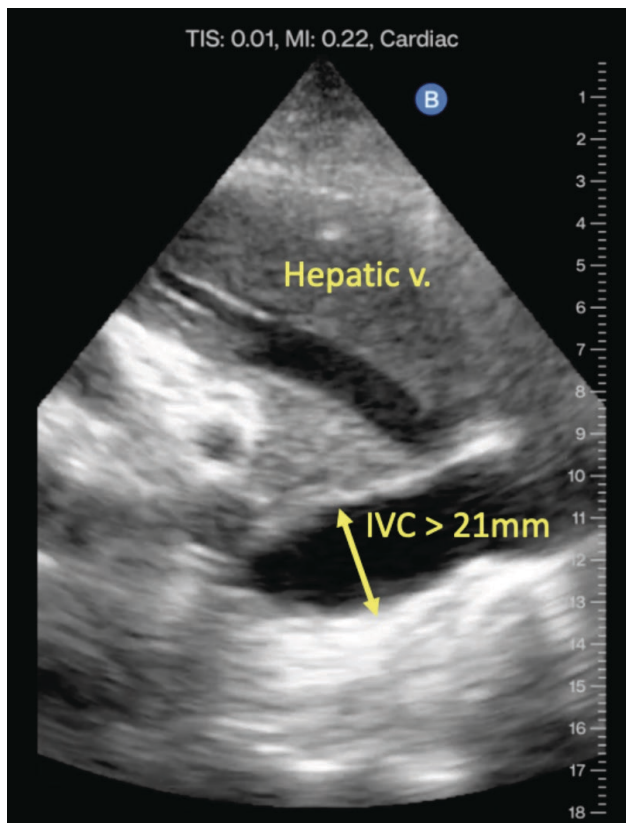
- Tamponade: a paradoxical movement of the RV free wall in which the RV wall moves towards the septum in diastole. During diastole, the RV should be filling; if the RV free wall is collapsing inwards, it can lead to hemodynamically significant decreases in preload.



3. Hemopericardium: In this case, the effusion surrounding the heart also has a more echogenic characteristic, representing blood.



4. Plethoric IVC: a clinically significant pericardial effusion will lead to a plethoric IVC, meaning the IVC is dilated > 21mm in diameter and is not decreasing with respiration. A plethoric IVC is 97% sensitive for cardiac tamponade.⁴



Pitfalls and Pearls

1. The subxiphoid view is the most sensitive for detecting a pericardial effusion because it can visualize dependent fluid when the patient is upright or reclined. The subxiphoid view is also used for pericardiocentesis.
2. Echo features of tamponade include systolic right atrial collapse and early diastolic right ventricle collapse. Making this determination is beyond the scope of our POCUS curriculum. Any imaging concerning tamponade should trigger a STAT formal echocardiogram, cardiology consult, and conversation with your attending.
3. Small pericardial effusions can also cause tamponade physiology.
4. In addition to the POCUS study, remember your physical exam! Beck's triad is a combination of muffled heart sounds, hypotension, and jugular vein distention. You can also evaluate for a pulsus paradoxus.

Acknowledgments:

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