Case Report:
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A cardiac mass diagnosed using point-of-care ultrasound in a dyspneic patient

An integrated ultrasound examination of lung-heart-inferior vena cava

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Case Presentation

A 74-year-old woman with history of hypertension presented to the Emergency Department (ED) with severe resting dyspnea and swelling in the feet, ankles and legs. She was on treatment with furosemide and a beta blocker. At the time of admission blood pressure was 145/88 mmHg, heart rate (HR) 99 bpm, regular, oxygen saturation was 89% (FiO2 21%) and respiratory rate was 17 breaths/min. Chest auscultation revealed no significant abnormality. Cardiovascular examination revealed normal cardiac rhythm and extremities’ pitting edema. The ECG exhibited sinus rhythm (HR=99 bpm), right bundle branch block (RBB) and left anterior fascicular block (LAFB).

Blood tests revealed leukocytosis of 13,900 cells per mm3, N-Terminal pro-Brain Natriuretic peptide (NT-pro-BNP) level of 23336 pg/mL (normal, < 125 pg/mL), international normalized ratio of 1.59, bilirubin level of 3.12 mg/dL (normal, < 1.2 mg/dL), Aspartate aminotransferase (AST/GOT) level was 71 UI/L (normal, <40), Glomerular Filtration Rate (GFR) was 54.32 mL/min/1.73 m² and electrolytes were within normal parameters. The patients denied previous viral hepatitis or other liver disease. Chest radiography appeared normal.

Point-of-care ultrasound (POCUS) with pocket size device was done upon arrival in ED (online Video S1-1a-2).

Discussion

On POCUS the parasternal long axis view showed left ventricle normal in size and function. From Apical 4-chamber view a large mass in the right atrium (RA) extending to or originating from the inferior vena cava (IVC) (online Video S1) was found with clear impairment of tricuspid valve function (online Video S1a). Point-of-care abdominal ultrasound revealed a hepatic lesion extending in the IVC (Figure 1, online Video S2) and into the RA. Lung ultrasound showed predominantly A-Profile bilaterally.

The patient underwent Contrast-enhanced CT scan of abdomen and thorax that showed a large liver lesion (15x12x12 cm) suggestive of Hepatocellular Carcinoma (HCC) extending into IVC and RA and multiple right lung segmental perfusion defects (Figure 2).

Our diagnosis was: pulmonary microembolism due to neoplastic mass infiltrating the inferior vena cava and the right atrium.

Among cardiac masses secondary tumors are a hundred times more common than primary cardiac lesions and they are, usually, located in the right side of the heart [1][2]. Metastasis may reach the heart via the lymphatic or hematogenous route, or by direct or transvenous extension [1]. Hepatocellular carcinoma accounts for 1-2.5% of all cancer in America with extension to inferior vena cava and right atrium in 1-4% of the cases [3].

Symptom presentations for cardiac tumors is quite varied, but it is dependent upon tumor location and size, rather than upon histologic characteristics. Presentation includes congestive heart failure from intracardiac obstruction, systemic or
pulmonary embolism, constitutional symptoms, and arrhythmias [4].

Rarely, right atrial tumors or large thrombi in the right atrium can mimic tricuspid stenosis (TS) obstructing the right ventricular inflow tract as in our patient [5].

NT-proBNP is a quantitative marker of Heart Failure (HF) affected by both systolic and diastolic left ventricular (LV) dysfunction, but markedly elevated NT-proBNP is also common in cancer patients [6]. In patients with right ventricular (RV) pressure overload due to primary pulmonary hypertension and thromboembolism, plasma BNP levels correlate with mean pulmonary artery pressure, right atrial pressure, RV end-diastolic pressure, and total pulmonary resistance [7]. Thus, it is conceivable that elevated levels of NT-proBNP in our patient are due to thromboembolism, pulmonary hypertension.

We describe a case of HCC that extended to the IVC and the RA complicated by pulmonary embolism. The main clinical manifestation of vena cava extension of the tumor is peripheral edema as in our case. Possible cardiopulmonary complications include heart failure, tricuspid insufficiency, ventricular out-flow tract obstruction, sudden cardiac death, pulmonary metastasis, secondary Budd–Chiari syndrome, pulmonary embolism and tricuspid stenosis, in particular our patient presented these two last complications [8].

This case is a timely reminder of the role that rapid evaluation by lung-cardiac-inferior vena cava integrated ultrasound retains in the management of the dyspneic patients, particularly when cases are complicated [9]. Routine POCUS in patients with acute dyspnea allows timely assessment of heart size and function, and also rapid evaluation of lung and IVC that together with clinical assessment are able to identify the correct diagnosis within the different clinical pictures of dyspneic patients [10]. Furthermore it allows to recognize a wide spectrum of conditions that are notably difficult to identify in the first assessment of the patients without more costly imaging modalities [11].

Conclusions

The integrated ultrasound examination of lung-heart-inferior vena cava is an extension of the clinical examination. In particular, Point-of-care ultrasound done in emergency department can be of a great help in rapid identification of correct diagnosis in patients with heart failure even in presence of rare conditions (such as cardiac masses) that require usually more advance imaging modalities.

References

Type 1 aortic dissection presenting as acute pericarditis: the roles of POCUS and transthoracic echocardiography

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Abstract

Clinical Presentation: A 59 year old male presented with a 1 day history of non-exertional chest pain that was pleuritic in nature and aggravated by lying flat. His chest pain symptoms were preceded by a one week history of “flu-like” symptoms. Physical exam demonstrated a blood pressure of 114/55 mmHg, heart rate of 75 bpm, and a normal oxygen saturation on room air. Cardiac examination revealed a bicuspid aortic valve with moderate aortic insufficiency. The aortic root and ascending aorta were dilated at 50 and 52 mm, respectively. There was evidence of an aortic dissection flap prolapsing across the left ventricular outflow tract. A dissection flap was also visualized within the abdominal aorta consistent with a Type 1 aortic dissection. Computed tomography of the aorta confirmed the Type 1 aortic dissection and the patient underwent an urgent valve-sparing aortic root replacement procedure. Discussion Points: Despite a typical clinical presentation for acute pericarditis, any unexpected physical exam or laboratory findings should lead to a POCUS assessment. This case demonstrates a rare presentation of aortic dissection which could have been easily missed without a POCUS assessment. Here we propose an algorithm for a POCUS examination in setting of pleuritic chest pain consistent with pericarditis.

Clinical Presentation

A 59 year old male presented with a 1 day history of non-exertional chest pain that was pleuritic in nature, aggravated by lying flat, and improved with sitting up. His chest pain symptoms was preceded by a one week history of “flu-like” symptoms with subjective chills. He denied shortness of breath, paroxysmal nocturnal dyspnea, or lower extremity edema. Home medication included allopurinol and tamsulosin. On physical exam, his blood pressure was 114/55 mm Hg, heart rate of 75 bpm, and a normal oxygen saturation on room air. Cardiac examination revealed a normal S1 and S2 with a bicuspid aortic valve compared to a normal S1 and S2 with a bicuspid aortic valve vs. a to-and-fro murmur. EKG demonstrated diffused ST-elevation and PR depression consistent with acute pericarditis (online Figure S1A). Chest X-ray was normal (online Figure S1B). Laboratory revealed a normal WBC of 11.2 x 10^9/L (Normal 3.5-10.5 x 10^9/L) and high sensitivity TsTnT of 78 ng/L (Normal <15 ng/L) (Table 1).

Imaging Findings

A point of care ultrasound (POCUS) operated by a PGY-6 Cardiology resident (using a GE VscanTM with single probe for 2D imaging and Doppler flow), demonstrated a parasternal long, apical 3 chamber, and apical 5 chamber views (images not available) visually mild aortic insufficiency with a dilated ascending aorta with no pericardial effusion. Using the reference ruler on the GE Vscan, the ascending aorta was estimated at approximately 5 cm in size. This triggered an expedited transthoracic echocardiography (TTE) confirming a bicuspid aortic valve with moderate aortic insufficiency and no pericardial effusion (Figure 1A-B, online Video S1 and S2). The aortic root and ascending aorta were dilated at 50 and 52 mm (Figure 1C), respectively, with evidence of an aortic dissection flap prolapsing across the left ventricular outflow tract (Figure 2A-C, online Video S3, S4 and S5). A dissection flap also visualized within the abdominal aorta (Figure 2D) (online Video S6). Computed tomography of the aorta confirmed the Type 1 aortic dissection (Figure 3, online Video S7). Patient underwent an urgent valve-sparing aortic root replacement procedure.

Table 1. Laboratory findings.

<table>
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<tr>
<th>Electrolytes</th>
<th>Normal</th>
<th>WBC</th>
<th>Hemoglobin</th>
<th>Platelets</th>
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<td>Urea</td>
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<td>114 g/L</td>
<td>115 x 10^9/L</td>
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<tr>
<td>Creatinine</td>
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<td>CRP</td>
<td>113 mg/L</td>
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Figure 1. Parasternal long axis demonstrating a dilated aortic root (A) with mild-to-moderate aortic insufficiency on colour Doppler (B), and ascending aorta measuring 5.2 cm (C).
Discussion Points

Despite a typical clinical presentation for acute pericarditis, a quick POCUS exam should be conducted to evaluate for a concomitant pericardial effusion. If any unexpected physical exam or laboratory findings are present, including new regurgitant murmurs or elevated cardiac biomarkers, a more detailed POCUS assessment by a trained professional should be performed to rule out high-risk features. Specifically, the presence of a large pericardial effusion with tamponade physiology or wall motion abnormalities suggesting myopericarditis should be evaluated. This case demonstrates a rare presentation of an aortic dissection which could have been easily missed without a detailed POCUS assessment. We propose an algorithm for a POCUS examination in setting of pleuritic chest pain consistent with pericarditis (Figure 4).

Conclusion

This case demonstrates the role of POCUS as a powerful tool for a rapid assessment of cardiac abnormalities in setting of pericarditis, in order to rule out high risk features. This is not a new feature and has been used in other specialties including emergency care and trauma with Focused Assessment with Sonography for Trauma (FAST) evaluation [1]. As the portable hand held scanners have become more versatile and part of standard care, cardiologists and other trained professional are performing rapid cardiac assessment to evaluate pericardial effusion [2] and to provide clues for evaluation of dyspnea or chest pain either in the clinic or in the acute hospital setting [3-5]. Some argue that POCUS will become part of a standardized bedside physical examination and improve bedside diagnosis [6].

References

Early signs of tamponade may be detected by cardiac point-of-care ultrasound

by Michael Cenkowski, MD¹, Amer M. Johri, MD², Raveen Pal, MD², Jennifer Hutchison, RDCS³

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Case
A 35-year-old male with a past medical history of end stage renal disease on hemodialysis and a chronic pericardial effusion secondary to dialysis presented to the Emergency Room (ER) with a 2-week history of a flu-like illness and pleuritic chest pain. He was compliant with dialysis three times per week. His blood pressure was 150/85 mmHg with a heart rate of 85 beats per minute and the remainder of his vital signs were stable. Pulsus paradoxus was not present. His jugular venous pulsation (JVP) was not visible, he had soft heart sounds, and no pericardial rub was heard. An ECG showed sinus rhythm with low voltages. Chest X-ray showed an enlarged cardiac silhouette. A point-of-care ultrasound (POCUS) exam using a hand-held GE V-scan® probe was used to look for a pericardial effusion. Two sets of subcostal images, performed 3 hours apart, are shown below (Figures 1 & 2; see also online Videos S1-S4). The patient’s blood pressure and heart rate during the second set of images was 160/90 mmHg and 75 bpm respectively. A formal transthoracic echocardiogram conducted following the first set of POCUS images confirmed that there was a 3 cm circumferential pericardial effusion that had increased in size from a baseline of 1.5 cm. There was partial early systolic right atrial collapse but no other features of cardiac tamponade.

Question
What intervention was likely performed between the 2 sets of images?
A. Pericardiocentesis with removal of 500 cc of pericardial fluid.
B. ASA 650 mg and Colchicine 0.5 mg PO
C. 500 cc bolus of NS
D. Lasix 40 mg IV with 500 cc of diuresis

(Answer after References section)

The case is of a 35-year-old male with acute pericarditis complicated by a large pericardial effusion with no evidence of tamponade clinically. The initial POCUS images show mild partial collapse of the right atrium with a small (< 2cm) and collapsing (> 50%) inferior vena cava (IVC) suggesting volume depletion. The patient then received 500 cc of fluids during his scheduled dialysis session and a repeat POCUS scan 3 hours later shows near resolution of the right atrial collapse.

A pericardiocentesis (option a) is unlikely to have been performed on this patient since the amount of pericardial fluid has not changed. A removal of 500 cc would be expected to have seen a significant decrease in the size of the effusion.

Although high dose ASA and Colchicine (option b) are used to treat pericarditis, and may reduce inflammation and accelerate resorption of the pericardial fluid, three hours is too early to begin seeing a hemodynamic response to these drugs.

The diuretic effect (option d) would be expected to reduce intravascular volume and lower right atrial pressure. The expected response would be to increase the degree of right atrial collapse.

Case discussion
This case illustrates important aspects of cardiac tamponade physiology. Given the stable blood pressure, the patient was not in clinical tamponade. However, the POCUS images showed evidence of right atrial collapse, an early feature

Figure 1. Subcostal view in early diastole showing inversion of the right atrium.

Figure 2. Subcostal image in early diastole taken 3 hours later. Right atrial inversion is no longer seen.
Research

of the hemodynamic effect of increasing pericardial pressure. This case illustrates that tamponade is a pathophysiologic continuum rather than an “all or none” phenomenon and the clinical manifestations of tamponade only occur in the latest stages of this continuum [1]. Cardiac tamponade is classically defined as compression of the heart by the accumulation of pericardial fluid under pressure [2]. When pericardial fluid accumulates slowly, pericardial compliance increases to accommodate the increase in volume, without an increase in pressure. As the pericardial fluid volume increases, the intrapericardial pressure increases. With a further increase in pericardial fluid, the pericardium eventually becomes maximally stretched and can no longer expand to accommodate the additional pericardial volume [3]. The intrapericardial volume becomes fixed and the heart must compete with the intrapericardial fluid for this fixed volume. As the intrapericardial pressure increases, it first equalizes with the lower right sided chamber diastolic pressures, and then the left. The result is decreased chamber size and diastolic filling, chamber collapse and a subsequent reduction in stroke volume. This results in falling of cardiac output and blood pressure which manifests as clinical cardiac tamponade. The right atrium is the first chamber to show signs of early compression, due to its thinner walls. Right atrial collapse is an extremely sensitive marker of cardiac tamponade, with a reported sensitivity of 100% and specificity of 82% in one study [4].

The physiologic findings of tamponade may occur earlier and at lower intra-pericardial pressures in hypovolemic patients. This phenomenon is known as “low pressure tamponade”. Clinical recognition of low pressure tamponade may be difficult because most patients lack the typical physical findings of pulsus paradoxus and distended neck veins. In the case of our patient, the small (< 2 cm) and collapsing (> 50%) inferior vena cava suggested a low right atrial pressure of approximately 3 mmHg. Although a formal diagnosis requires a cardiac catheterization measuring intrapericardial and right atrial pressures, it is likely that our patient was in the very early stages of low-pressure tamponade that improved with the administration of fluids. Patients with low pressure tamponade may improve with fluids initially, but more severe cases often require aspiration of the effusion [5,6].

Another important concept within the continuum of cardiac tamponade is that of “ventricular interdependence”, which is the physiologic basis of the pulsus paradoxus. It is important to note that a hand-held ultrasound machine may not be capable of showing this phenomenon. A formal echocardiogram with Doppler is required to show signs of ventricular interdependence.

POCUS has not been validated for the purposes of diagnosing tamponade and a thorough clinical exam, formal echocardiogram, and possible cardiac catheterization remain the gold standard [7]. Nevertheless, this case shows that with good image quality, POCUS may demonstrate some dynamic pathophysiologic changes within the spectrum of cardiac tamponade. There has been a growing interest in integrating bedside ultrasound training into the medical undergraduate curriculum. Comprehensive studies show that bedside ultrasound is a skill that medical students are able to learn and enhances their anatomy knowledge, clinical accuracy and physical exam skills [8,9]. The focus of this training has been in the acquisition of ultrasound operational skills. This case demonstrates another potential way of incorporating ultrasound into the medical curriculum, whereby an experienced imager may use the hand-held ultrasound device as a bedside teaching tool to aid in the understanding in complex cardiac pathophysiology. Future studies are needed to determine whether this application of bedside ultrasound is of value for trainees. Finally, the utility of cardiac POCUS to assist in fluid management in the renal unit, as in this case, may be an interesting area of future study.

References

3. Roy CL, Minor MA, Brookhart MA, Choudhry NK. Does This Patient With A Pericardial Effusion Have Cardiac Tamponade? JAMA. 2007 Vol 297, No. 16; 297: 1810-1818

Answer: c)
Announcements

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The Canadian Society of Echocardiography has formed a new POCUS subcommittee. More information coming soon csecho.ca

The American Society of Echocardiography is in the process of creating a POCUS taskforce. More information coming soon. asescientificsessions.org

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