A Sinister Point of Care Ultrasound (POCUS) Finding in a Patient with New Heart Failure

Linden Kolbenson, MD, FRCPC1, Irene W. Y. Ma, MD, PhD, FRCPC2, Paul Olszynski, MD, Med, CFPC-EM3

1Division of General Internal Medicine, University of Saskatchewan, Saskatoon, Saskatchewan, Canada; 2Division of General Internal Medicine, University of Calgary, Calgary, Alberta, Canada; 3Department of Emergency Medicine, University of Saskatchewan, Saskatoon, Saskatchewan, Canada

Corresponding Author: Linden Kolbenson: linden.kolbenson@gmail.com

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Abstract
Decompensated heart failure is a common clinical syndrome encountered by internal medicine physicians. Identifying the reason for decompensation is vital to managing this condition but may require several investigations throughout a hospital admission. Herein, we describe a patient who presented with new presumed decompensated heart failure. Upon clinical deterioration, point of care ultrasound (POCUS) identified the presence of mitral valve vegetation and evidence of aortic and mitral regurgitation, supporting and expediting the presumptive diagnosis of infective endocarditis.

Case Report
A 74-year-old man presented to a community hospital emergency department with a 2-day history of progressive dyspnea. He described mild bilateral leg edema but denied orthopnea, paroxysmal nocturnal dyspnea, chest pain, cough, palpitations, syncope, or presyncope. He had a history of well-controlled hypertension and prostate cancer treated 19 years prior with transurethral resection of the prostate. He was a lifelong non-smoker. He did not drink alcohol or use recreational drugs. His home medications included hydrochlorothiazide and ramipril. He was living independently in a senior’s home.
Initial evaluation of the patient during this presentation revealed that he was in no obvious distress. He was alert and oriented to person, place, and time. He was afibrile. His blood pressure was 158/65 mmHg and his heart rate was 78 beats/minute and regular. His oxygen saturation was 97% on oxygen at 3 litres/minute via nasal cannula. His respiratory rate was 22 breaths/minute. Physical examination revealed 2+ bilateral pitting edema to the shins. There were no signs of deep vein thrombosis. There were no skin or nail changes. There was mild increased work of breathing and crackles heard at the bases of the lungs. Heart sounds were normal, with no extra sounds or murmurs heard.

Relevant initial investigations included a normal white blood cell count with a differential revealing neutrophilia and lymphopenia. High sensitivity c-reactive protein was elevated at 77 mg/L (0.0–7.0 mg/L). N-terminal-pro-brain natriuretic peptide (Nt-pro-BNP) was elevated at 7319.00 ng/L (0.00–125 ng/L). Highly sensitive troponin T was elevated at 175.0 ng/L (<14.0 ng/L) with a normal creatinine kinase. Electrolytes, urea, creatinine, and liver enzymes were normal. A chest radiograph revealed new small bilateral pleural effusions, mild cardiomegaly, and vascular redistribution. A 12-lead electrocardiogram revealed sinus rhythm with a first-degree atrioventricular block, right bundle branch block, and left anterior fascicular block. There were no findings suggestive of ischemia.

The emergency department physician made a preliminary diagnosis of decompensated heart failure. The patient was started on intravenous furosemide and was consulted to the internal medicine service for further management and admission to hospital. A transthoracic echocardiogram (TTE) was ordered. Since the patient had presented to care on a Friday evening at a community hospital with limited after-hours specialist support, the TTE was unlikely to be performed until the following week. During the subsequent consultation by the internal medicine service, the patient had a marked change in clinical status. He now appeared pale and diaphoretic. His respiratory rate had increased to 30 breaths/minute. His heart rate had increased to 100 beats/minute while his remaining vital signs were unchanged. Repeat physical examination revealed bounding pulses but no new findings from the previous examination. Additional history revealed that he was admitted to hospital 10 days before admission for a urinary tract infection complicated by Streptococcus agalactiae bacteremia and acute urinary retention. He was discharged with a plan to complete a 2-week course of ceftriaxone to which the streptococcus was sensitive. He did not have a TTE performed during that admission. A comparison of his current ECG with a previous tracing revealed that his first-degree atrioventricular block was new since his last admission. We performed cardiac POCUS which revealed a mobile mass on the atrial side of the anterior mitral valve leaflet, an abnormal appearing aortic valve, and the presence of aortic and mitral regurgitant colour Doppler jets (Figure 1–4). These findings along with the patient’s clinical deterioration led

**Figure 1.** Parasternal long axis view still images showing irregularity of the right coronary cusp of the aortic valve (red arrow). Ao = ascending aorta; LA = left atrium; LV = left ventricle; RV = right ventricle.
Figure 2. Apical two-chamber view still images showing a vegetation (red arrow) arising from the mitral valve. LA = left atrium; LV = left ventricle; MV = mitral valve.

Figure 3. Apical two-chamber view still image with colour Doppler showing mitral regurgitant jet. LA = left atrium; LV = left ventricle.
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Three sets of blood cultures were immediately drawn. Vancomycin was started in addition to the ceftriaxone the patient was already receiving. Urgent cardiology consultation was obtained, and with the patient’s consent the de-identified video clips were shared with the cardiologist via text message. Despite never having had a comprehensive TTE performed the patient was urgently transferred to a tertiary care hospital under the cardiology service after a discussion of the case and remote review of the POCUS images. The patient underwent emergent cardiac surgery 7 hours later. An emergent TTE was performed at the tertiary hospital. This study and an intraoperative transesophageal echo (TEE) confirmed the presence of aortic and mitral valve vegetations, severe aortic regurgitation, and a possible paravalvular abscess. Aortic valve replacement and left ventricular outflow tract bovine patch repair were performed. Intraoperative findings were significant for a

Figure 4. Apical five-chamber view still images showing the presence of irregular aortic valve (green highlight) and mitral valve vegetation (red highlight). Bottom images with colour Doppler show an aortic regurgitant jet (dashed line). AMVL = anterior mitral valve leafl et; AR = aortic regurgitation; AV = aortic valve; LA = left atrium; LV = left ventricle; RA = right atrium; RV = right ventricle; PMVL = posterior mitral valve leafl et.
large mitral valve vegetation, a bicuspid aortic valve with a destroyed and fragmented noncoronary cusp. An abscess extending down the aorto-mitral curtain was also found. The patient did well postoperatively and was discharged 1 week later.

Discussion

Infective endocarditis is a life-threatening disease that is difficult to diagnose. Classic immunologic and vascular phenomena such as Osler nodes and Janeway lesions occur in only 2.7% and 1.6% of patients. Fever and cardiac murmur are more common findings occurring in 90% and 85% of patients but are non-specific. As illustrated in our case, the patient had no fever, murmur, or peripheral skin changes consistent with the diagnosis. In cases of complicated left-sided native valve infective endocarditis such as ours, 6-month mortality can be as high as 26%. Delay in diagnosis is associated with worse outcomes, and early surgical intervention in select patients can reduce embolic events.

In this case the patient had an undiagnosed bicuspid aortic valve predisposing him to endocarditis. His aortic valve was likely seeded during his *Streptococcus agalactiae* bacteremia with subsequent involvement of his aortic root and anterior mitral valve leaflet over time. His rapid decomposition during his presentation could be explained by the perforation of an aortic valve leaflet leading to acute severe aortic regurgitation.

Prompt diagnosis of infective endocarditis facilitates initiation of appropriate antimicrobial therapy, early specialist consultation, and identification of patients who may benefit from surgery. Comprehensive TTE is essential in the initial evaluation of this disease. The presence of a vegetation, defined as an independently mobile echodense mass typically implanted on the low-pressure side of a valve or mural endocardium in the trajectory of a regurgitant jet or implanted in prosthetic material with no alternative anatomical explanation, is a supportive finding on TTE for infective endocarditis and is a major criterion in the Modified Duke Criteria. TTE is noninvasive and more available than TEE. However, in our centre non-urgent comprehensive TTE can take several days to obtain and is generally unavailable on weekends. Urgent TTE is available only in consultation with cardiology.

Cardiac POCUS or focused cardiac ultrasound (FoCUS) is increasingly used to evaluate patients with dyspnea and respiratory failure like ours. In contrast to comprehensive TTE, FoCUS is used at the bedside to answer specific questions via assessment of several cardiac parameters. For example, the core components of FoCUS have been described as qualitative or semiquantitative evaluation of left ventricular size and systolic function, right ventricular systolic function, pericardial effusion and tamponade physiology, volume status, and detection of gross signs of chronic cardiac disease and intracardiac masses. International recommendations acknowledge the complexity of valvular assessment and propose that Doppler techniques are beyond the scope of FoCUS. However, in certain scenarios FoCUS can include assessment for clues of gross valvular disease including valvular masses. Core POCUS applications historically were concerned with the answer of binary yes and no questions. As core POCUS applications expand and evolve over time, there is increasing recognition that scanning, interpretation, and clinical integration require a more nuanced and sophisticated approach. The inherent complexity of the internal medicine patient necessitates a departure from dichotomy in favour of careful consideration and integration of all relevant data obtained from POCUS assessments to ultimately inform management decisions.

The use of POCUS in the diagnosis of infective endocarditis has been described in several previous case reports. It is important to note the limitations of both POCUS and TTE in the evaluation of possible infective endocarditis. The absence of valvular abnormalities does not rule out infective endocarditis since small vegetations may not be seen on even comprehensive TTE. POCUS is at an even higher risk of missing abnormalities. Positive findings must also be interpreted cautiously. Vegetations must be differentiated from normal valve variants such as Lambl’s excrescence and other pathology, including thrombus, papillary fibroelastoma, and myxomatous mitral valve disease. One must also consider the possibility of non-bacterial thrombotic endocarditis and vegetations that persist from previously treated infective endocarditis. In general, POCUS should not be used to rule out infective endocarditis, and valvular assessment is typically considered beyond the scope of most POCUS practitioners. However, in a patient with a high pretest probability of infective endocarditis, in the hands of an experienced POCUS practitioner, the finding of mobile vegetation with valvular regurgitation may be highly suggestive. This case shows that integration of positive findings on cardiac POCUS and careful clinical judgement can substantially alter the clinical trajectory of a patient, such as expediting care.
POCUS educational development is ongoing in training centres across Canada, with recent educational indicators published to help guide ongoing curriculum development and implementation. Additionally, an increasing number of internal medicine programs in Canada are implementing longitudinal POCUS curricula. All physicians and trainees in internal medicine should consider pursuing training in POCUS to supplement their clinical skills. Additionally, FoCUS should be considered in any patient with a cardiopulmonary concern especially if there has been a change in clinical status as evidenced in this case. Educators should ensure trainees understand normal valvular appearance on FoCUS and consider the use of colour Doppler in augmenting valvular assessment in select patients. Learners should also approach obvious valvular abnormalities seen on POCUS, such that consultation with an expert or a request for consultative imaging such as TTE can occur appropriately.

Recent publications have questioned the ability of broadly applied POCUS protocols to alter clinical outcomes in a meaningful way. The value of POCUS lies in integrating findings into the larger clinical picture and incorporating POCUS findings with interventions that can meaningfully change outcomes. As evidenced in this case, POCUS findings could expedite care for this patient in a way that would not have occurred without POCUS.

Conclusion

In a case of a rapidly decompensating patient with new heart failure, integration of cardiac POCUS by the internal medicine physician rapidly refined the preliminary diagnosis and expediently altered the patient’s management plan. Currently the role of cardiac POCUS in the dyspneic patient presenting to hospital is undefined. However, in select patients it may profoundly impact care. Focused research on this application of POCUS during initial consultation should be pursued.

Author Contributions

Linden Kolbenson was involved in the care of the patient. Linden Kolbenson also designed the case report, selected the images, and drafted and revised the manuscript. Paul Olszynski contributed to the selection of images and the revision of the manuscript. Irene Ma also contributed to the selection of images, and the revision of the manuscript.

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Competing Interests

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References


Supplementary Video

Video 1:
Apical two chamber view of the heart showing an echogenic mobile mass attached to the atrial side of the mitral valve consistent with a vegetation.

Video 2:
Apical two chamber view of the heart with colour Doppler demonstrating mitral regurgitation.

Video 3:
Zoomed apical five chamber view of the heart showing an irregular aortic valve and a mitral valve vegetation.

Video 4:
Zoomed apical five chamber view of the heart with colour Doppler demonstrating both mitral and aortic regurgitation.