

Focus on POCUS: Carcinoid Heart Disease Found with Point-of-Care Ultrasound during Basic Physical Exam



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INTRODUCTION

Point-of-care ultrasound (POCUS) is an innovative clinical tool and should be considered in conjunction with basic physical examinations.^{1,2} It can help guide primary care clinicians in the evaluation and management of common and potentially rare medical conditions.³⁻⁵ We present a case of carcinoid heart disease that was identified by a trainee physician using POCUS in combination with a clinical examination.

CASE PRESENTATION

A 48-year-old man with no prior medical conditions presented with exertional dyspnea, lower extremity edema, abdominal fullness, and chronic diarrhea. Initial vital signs revealed a blood pressure of 114/82 mm Hg, heart rate of 84 bpm with regular rhythm, and respiratory rate of 16 brpm with a 95% oxygen saturation on ambient air. Physical examination demonstrated a parasternal impulse, auscultation of a left sternal holodiastolic murmur, and an apical holosystolic murmur with a normal rate and regular rhythm. Evaluation at the bedside revealed jugular venous distention with a distinct CV waveform. The rest of his exam revealed hepatomegaly with abdominal distention and pitting edema of the bilateral lower extremities. POCUS (GE Vscan Dual Probe handheld scanner; General Electric Company, Boston, MA) obtained at the time of examination revealed thickened and tethered tricuspid valve leaflets, dilated right atria, and cystic lesions within the liver (Figure 1, Video 1) as well as a right ventricular dilation and wall hypokinesis (not shown). Given his constellation of symptoms, exam findings, and POCUS findings, the leading differential diagnosis was carcinoid heart disease.

Transthoracic echocardiography (TTE) confirmed the initial POCUS findings along with evidence of an ejection fraction of

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VIDEO HIGHLIGHTS

Video 1: POCUS findings. **(A)** Apical four-chamber view revealing restricted mobility of the TV (*red arrow*), RA dilation, and IVS with a leftward motion in diastole consistent with right ventricular volume overload. **(B)** Parasternal long-axis view of the right ventricular inflow demonstrates thickening and shortening of the tricuspid valve leaflets (*red arrow*). IVS, Intraventricular septum; LA, left atrium; RA, right atrium; RV, right ventricle; TV, tricuspid valve.

Video 2: TTE color Doppler findings. **(A)** Apical four-chamber view with color Doppler assessment of the tricuspid valve showing a large central holosystolic jet with severe turbulence, a dilated RV, and mildly reduced RV systolic function by visual assessment. **(B)** Short-axis view color Doppler assessment of the RVOT demonstrates a central holodiastolic signal in the PV. Note the elevated gradient across the PV (>10 mm Hg) is likely due to the regurgitant volume from PR. PR, Pulmonic regurgitation; PV, pulmonic valve; RV, right ventricle; RVOT, right ventricular outflow tract.

Video 3: Cardiac magnetic resonance imaging findings: steady state free precession. **(A)** Apical four-chamber view demonstrating a dilated RV with reduced systolic function, a dilated RA with high right atrial pressures, and bowing of the intra-atrial septum (*red arrow*). The TV leaflets are thickened with poor coaptation during systole (*green arrow*). **(B)** Sagittal view of the RVOT demonstrates thickened pulmonic valve leaflets with poor coaptation (*green arrow*). **(C)** Short-axis view at the base reveals the thickened anterior, septal, and posterior tricuspid valve leaflets with malcoaptation of the leaflets as the mechanism of the valve regurgitation (*red and blue arrows*). Large cystic hepatic lesion within the left hepatic lobe (*white arrow*). **(D, E)** Phase contrast flow sequences through the pulmonic valve demonstrated a regurgitant volume of 35.9 mL with an RF of 52% consistent with severe PR. **(F)** TV regurgitant volume and fraction calculations estimated a regurgitant volume of 53.9-58.3 mL with a regurgitant fraction of 44%-47% consistent with moderate TR. LA, Left atrium; LVSV, left ventricular stroke volume; PA, pulmonary artery; PR, pulmonic valve regurgitation; RA, right atrium; RF, regurgitant fraction; RVSV, right ventricular stroke volume; RV, right ventricle; RVOT, right ventricular outflow tract; TR, tricuspid valve regurgitation; TV, tricuspid valve.

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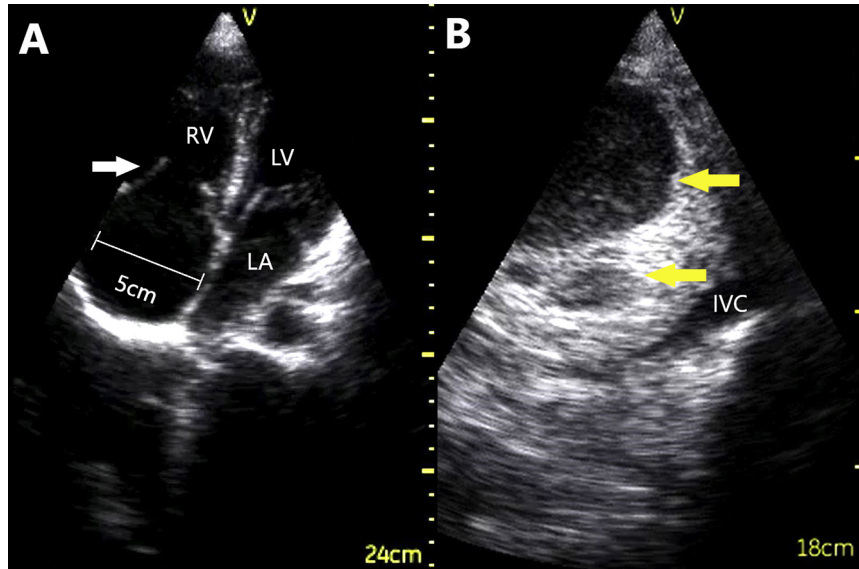


Figure 1 POCUS findings: **(A)** Apical four-chamber view demonstrates thickened and tethered TV (white arrow) and dilated RA (5 cm in diameter). **(B)** Subcostal view demonstrates multiple large cystic lesions within left hepatic lobe (yellow arrows) compressing the IVC. IVC, Inferior vena cava; LA, left atrium; LV, left ventricle; RA, right atrium; RV, right ventricle; TV, tricuspid valve.

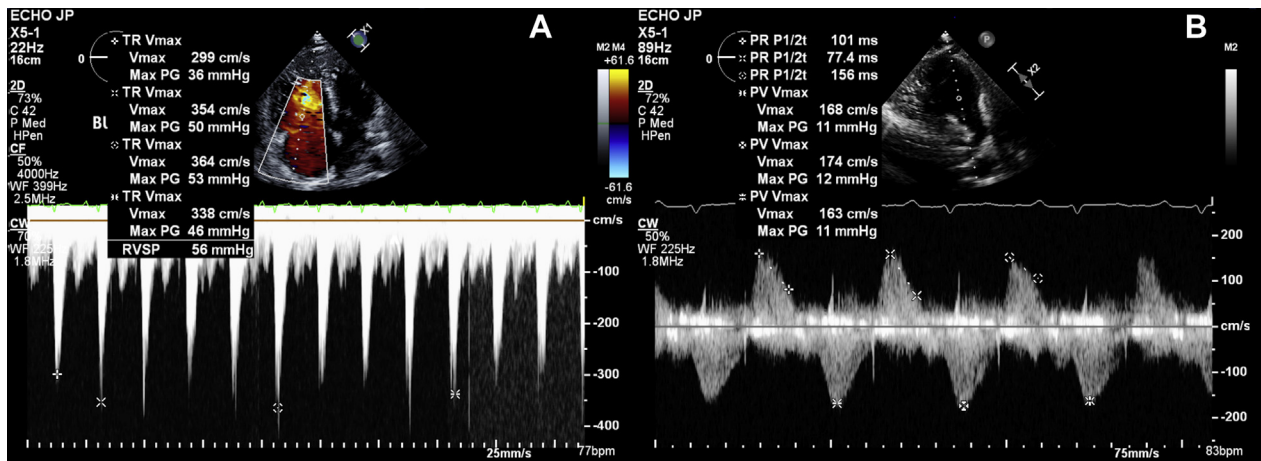


Figure 2 TTE spectral Doppler findings. **(A)** Continuous-wave spectral Doppler of the tricuspid valve demonstrates multiple dense signals with velocities consistent with elevated pulmonary arterial systolic pressures. **(B)** Right ventricular outflow tract continuous-wave spectral Doppler demonstrates equal systolic and diastolic blood velocities through the pulmonic valve with early termination of the PR spectrum (prior to the onset of the outflow spectrum), which is a very specific sign for severe PR. Images were acquired at time of physical exam findings indicative of acute heart failure with RV volume overload. PR, Pulmonic valve regurgitation; TR, tricuspid valve regurgitation.

55%-60% and right ventricular pressure/volume overload (Video 2). The imaging further revealed a thickened tricuspid valve leaflet with restricted mobility and elevated velocities across the tricuspid and pulmonic valve, consistent with severe regurgitation (Figure 2). Cardiac magnetic resonance imaging confirmed a moderately dilated right ventricle (end-diastolic volume of 248 mL), with a normal systolic function (ejection fraction of 49%) with severe tricuspid and pulmonic valve regurgitation (Video 3). Triphase computed tomography of the patient’s liver confirmed the presence of multiple mixed solid and cystic nonhypervascular masses. Laboratory findings and liver biopsy confirmed the presence of a well-differentiated carcinoid tumor (Table 1).

Following his diagnosis, our patient received therapy with a somatostatin analog (lanreotide 120 mg subcutaneous injections every 4 weeks) and was referred to a center of excellence for management of his carcinoid heart disease. The patient promptly received tricuspid and pulmonic valve replacement and is recovering well.

DISCUSSION

Carcinoid heart disease is a rare condition that develops as a manifestation of carcinoid syndrome in those affected by neuroendocrine tumors (NETs) or carcinoid neoplasms. These tumors are typically nonfunctional and predominantly arise from

Table 1 Laboratory studies and liver biopsy

Laboratory studies	Admission values	Reference range
Serum brain natriuretic peptide, pg/mL	241	<100
24-hour urine 5-hydroxyindoleacetic acid, mg	208.7	0-15
Serum 5-hydroxyindoleacetic acid, ng/mL	2,789	21-321
Serum chromogranin A, nmol/L	80	0-5
Serum gastrin, pg/mL	116	0-115
Hepatitis B virology	Negative	Negative
Hepatitis C virology	Negative	Negative
Liver biopsy	Well differentiated carcinoid neuroendocrine tumor	NA

NA, Not applicable.

neuroendocrine cells within gastrointestinal tract (GI-NETs).¹ Eventually, 10%-20% of GI-NETs progress to functional neoplasms that produce serotonin, bradykinin, histamine, prostaglandins, and other bioactive compounds. Systemic hormone release and subsequent clinical manifestations occur once primary GI-NETs metastasize to the liver and allow these compounds to bypass enzymatic breakdown within hepatocytes.¹⁻³ This results in flushing, watery diarrhea, bronchospasms, and hypotension and is termed "carcinoid syndrome."

Nearly 2 years after the diagnosis of carcinoid syndrome, around 40% of individuals develop carcinoid heart disease. Although the complete mechanism has not been fully elucidated, this is thought to occur after prolonged exposure of endocardial structures to the released bioactive compounds.^{2,3} Most patients with carcinoid heart disease show signs of right-sided heart failure, which portends a poor prognosis with mortality rates as high as 43% in untreated patients.¹⁻³ Due to its high morbidity, diagnosis at the earliest stage possible is important.

In our case, a second-year family medicine resident with roughly 30-40 cumulative hours of POCUS training was able to accurately identify findings of an uncommon cardiac condition with a POCUS-enhanced physical exam. Early use of POCUS facilitated urgent TTE evaluation and subspecialty involvement. In our institution, TTE is usually not completed until a patient is more euvoletic, and an in-patient cardiology consult is not generally obtained for routine heart failure exacerbation. However, because POCUS was performed, a complete TTE evaluation occurred earlier in the clinical course, expediting timely consultations from appropriate subspecialties (cardiology, gastroenterology, and interventional radiology) and a complete laboratory evaluation with liver biopsy. It also allowed for prompt acquisition of cardiac magnetic resonance imaging for further evaluation of the patient's valvular disease, which is not commonly performed in an inpatient setting. This multidisciplinary approach resulted in the quick diagnosis and treatment of this patient's carcinoid heart disease.

POCUS has gained widespread acceptance as a physical examination enhancement tool by primary care clinicians in a hospital and outpatient setting. POCUS allows clinicians to directly visualize cardiac features and perform more accurate identification of cardiovascular pathology than with auscultation alone.⁴⁻¹⁰ Even in the hands of a novice user, POCUS has been shown to be more accurate in identifying cardiovascular pathology when compared with physical exam by experienced clinicians.^{11,12} Additionally, it can help detect pathol-

ogy at early stages and help identify high-risk features, such as severe regurgitation and ventricular overload.^{13,14}

CONCLUSION

The case presented provides a real-world illustration of the utility of POCUS in an inpatient setting. Specifically, evidence of significant right heart failure that led to the eventual diagnosis of carcinoid heart disease was identified through POCUS-enhanced physical examination by a trainee physician. This approach led to the early request for a formal comprehensive TTE and subspecialty consultation, which led to early identification of disease and transfer to center of excellence for valve replacement.

SUPPLEMENTARY DATA

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.case.2021.09.002>.

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