

Left Ventricular Papillary Fibroelastoma Presenting with Dyspnea on Exertion



Storm de Klerk, MD, Calli Dogon, MD, Moshe Grossman, MD, Jeremy E. Adler, MD, Jeanne McFalls, MD, Satoshi Furukawa, MD, and Sheldon Goldberg, MD, *Philadelphia, Pennsylvania*

INTRODUCTION

Over the past few decades, cardiac papillary fibroelastoma (CPF) has shifted from being a tumor diagnosed mainly at autopsy to being one diagnosed with current imaging modalities, resulting in curative surgical potential.¹ Although CPFs are the most common benign valvular tumors, they account for <10% of all primary cardiac tumors, whose greater incidence, on the basis of autopsy findings, is a mere 2:10,000.² Traditionally, CPFs were thought to be less common than myxomas, but a recent surgical series found otherwise, indicating that overall, CPFs are possibly the most common type of primary cardiac tumor.³ Nonvalvular and multifocal CPFs remain exceedingly rare.^{4,5} Patients with CPFs have a mean age of 60 years at diagnosis, without a predominant gender, but CPFs can occur at any age.^{6,7} Histologically, they resemble avascular frondlike structures that are composed of fibroelastic tissue surrounded by endocardium. Grossly, they resemble a sea anemone, with a distinctive echocardiographic appearance. Clinically, CPFs are important because of their high embolic potential.³ CPFs are thought to be acquired rather than inherited, with possible contributing factors including trauma, organized thrombi, epithelial hyperproliferation from hemodynamic damage to the endothelium, and underlying genetic predisposition.^{6,8}

Nowadays, diagnosis of CPFs is increasing as a result of the widespread use of imaging. However, CPFs in rare locations, with associated atypical features and symptoms, may provide diagnostic difficulty, even when advanced multimodal imaging techniques are used. This situation results in the definitive diagnosis being made only after surgery. Precisely such a case is presented in this report.

CASE PRESENTATION

A 74-year-old man was seen by his outpatient cardiologist concerning recent onset of dyspnea upon exertion. Three months prior, he had been able to run 5 miles three or four times per week without diffi-

culty. At the time of his initial assessment, he was barely able to run 1 mile. Although the physical examination was unremarkable, resting electrocardiography revealed mild sinus bradycardia with left ventricular hypertrophy and inferolateral T-wave inversions. In office, transthoracic echocardiography (TTE) revealed a normal left ventricular ejection fraction, normal left ventricular wall motion, and an echodensity just posterior to the mitral valve within the left ventricle. The patient subsequently underwent exercise stress echocardiography, the exercise portion of which produced abnormal findings with additional 2- to 2.5-mm horizontal to down-sloping ST-segment depression in leads V₅ and V₆ and global hypokinesis with associated pallor and true dyspnea (reproduced outpatient symptom). He was therefore referred for diagnostic left heart catheterization. Left heart catheterization showed a distal 60% lesion in the left anterior descending coronary artery and nonobstructive right coronary artery and left circumflex disease. When fractional flow reserve was performed on the left anterior descending coronary artery lesion, however, it was found to be negative at 0.96. To better characterize the echodensity observed on initial TTE, cardiac magnetic resonance imaging (MRI) was performed (Figure 1). The scan showed an 11-mm ovoid structure in the region of the posterior annulus of the mitral valve. Given its location, the structure was thought to most likely be a mitral annular calcification. The lesion did not display early contrast enhancement on perfusion imaging, but it did display avid late gadolinium enhancement, prompting the inclusion of other differential diagnoses such as cardiac myxoma, despite the rare location, and papillary fibroelastoma.

Calcification is known to have a variable signal on MRI and is better confirmed with computed tomography (CT), which was subsequently recommended. Contrast-enhanced cardiac CT (Figure 2) later confirmed the presence of a heterogeneous low-attenuation mass within the left ventricle, compatible with a myxoma or other fibrous mass given the low attenuation but not diagnostic of one, leaving other cardiac tumors in the differential diagnosis. Finally, transesophageal echocardiography (TEE; Figure 3, Video 1) was conducted, which again showed a mobile echodensity attached to the left ventricular myocardium, located immediately apical to the posterior mitral valve leaflet and measuring 1.8 cm in the largest dimension. The appearance was again most consistent with a myxoma, although in an unusual location for such a tumor. A thrombus or nonmyxoma tumor could not be excluded upon completion of noncontrast TEE.

The patient was referred to cardiothoracic surgery and subsequently underwent surgical resection. The diagnosis was established when a 1.5-cm papillary fibroelastoma was discovered in the left ventricle (Figure 4) just beyond the posterior leaflet of the mitral valve and confirmed histologically (Figure 5). Six months after excision of the cardiac tumor, the patient reported resolution of the initial presenting symptoms. When he underwent stress echocardiography during preoperative testing before screening colonoscopy, the test revealed improved 0.5- to 1.0-mm horizontal and up-sloping ST-segment depressions in leads V₅ and V₆, with no wall motion

From the Department of Internal Medicine, University of Pennsylvania Health System (S.K., C.D.), the Department of Radiology (M.G.), the Department of Pathology (J.E.A., J.M.), Cardiovascular Surgery (S.F.), and Cardiovascular Education (S.G.), Pennsylvania Hospital, Philadelphia, Pennsylvania.

Keywords: Papillary fibroelastoma, Left ventricular mass, Benign cardiac tumor, Abnormal stress test results, Exertional dyspnea

Funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflicts of interest: The authors reported no actual or potential conflicts of interest relative to this document.

Copyright 2020 by the American Society of Echocardiography. Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

2468-6441

<https://doi.org/10.1016/j.case.2019.12.004>

278

VIDEO HIGHLIGHTS

Video 1: TEE shown in midesophageal four-chamber view revealing a mobile echodensity seen attached to the left ventricular myocardium, located immediately apical to the posterior mitral valve leaflet.

Video 2: TEE shown in midesophageal long-axis view revealing a mobile echodensity seen attached to the left ventricular myocardium, located immediately apical to the posterior mitral valve leaflet.

Video 3: TEE shown in transgastric two-chamber view revealing a mobile echodensity seen attached to the left ventricular myocardium, located immediately apical to the posterior mitral valve leaflet.

Video 4: TEE shown in transgastric basal short-axis view revealing a mobile echodensity seen attached to the left ventricular myocardium, located immediately apical to the posterior mitral valve leaflet.

[View the video content online at www.cvcasejournal.com.](http://www.cvcasejournal.com)

abnormalities and a normal left ventricular ejection fraction after 12 min of exercise per the Bruce protocol.

DISCUSSION

CPFs are for the most part asymptomatic and are usually found incidentally during echocardiography, cardiac surgery, or autopsies.¹ The

most dreaded complication is systemic embolization, resulting in stroke.¹ Although the mechanism of embolism remains poorly understood, it is possibly related to tumor fragments or thrombi attached to the tumor.⁹ Because of their fragile composition, segments of the tumor may dislodge, and additionally, the mucopolysaccharide- and hyaluronic acid-rich frond surface may harbor thrombi that may embolize.¹⁰ The risk for cerebrovascular accident (CVA) has been reported as approximately 6% at 1 year and 13% at 5 years.³ Other life-threatening cardiac and neurological manifestations—including angina, syncope, blindness, myocardial infarction, sudden death, and heart failure—have been reported.¹¹

Dyspnea is not a typical symptom of CPF.¹² It is likely even more uncommon when valvular structures and blood flow are not obviously impeded. Two cases of previously described patients with CPFs featuring symptoms of dyspnea involved valvular structures with resultant pulmonary embolism, in the first instance, and extremely rare obstruction of the right coronary ostium, in the second instance.¹²

In our case, the CPF did not appear to involve the mitral valve or impede ventricular filling, but dyspnea was nevertheless reported and presumed to play a role, given the resolution of symptoms after resection. Resection furthermore resulted in improved findings on follow-up stress echocardiography. These abnormalities are therefore less likely to be the result of untreated fractional flow reserve-insignificant left anterior descending coronary artery stenosis.

Multimodality imaging plays a key role in the assessment of cardiac masses in general and CPFs in particular. The diagnosis, and the accompanying differential diagnosis, is based on location, attachment, size, borders, mobility, enhancement, vascularity, and metabolism, among other factors.⁴ In our case, initial TTE showed an abnormality but was unable to characterize the mass in any detail. Both cardiac CT and MRI allowed further detailing; however, TEE was notably



Figure 1 Sagittal nonenhanced double inversion fast spin-echo cardiac MRI sequence demonstrated a hyperintense mass arising from the left ventricular free wall just below the posterior mitral valve (**A**). Perfusion enhancement imaging obtained 2 min after administration of intravenous (IV) gadolinium (not shown) demonstrated no early enhancement within the mass. Sagittal inversion recovery late gadolinium imaging obtained 20 min after IV gadolinium demonstrated avid enhancement of the mass adjacent to the nulled left ventricular free wall myocardium (**B**). Arrows denote the location of the CPF.

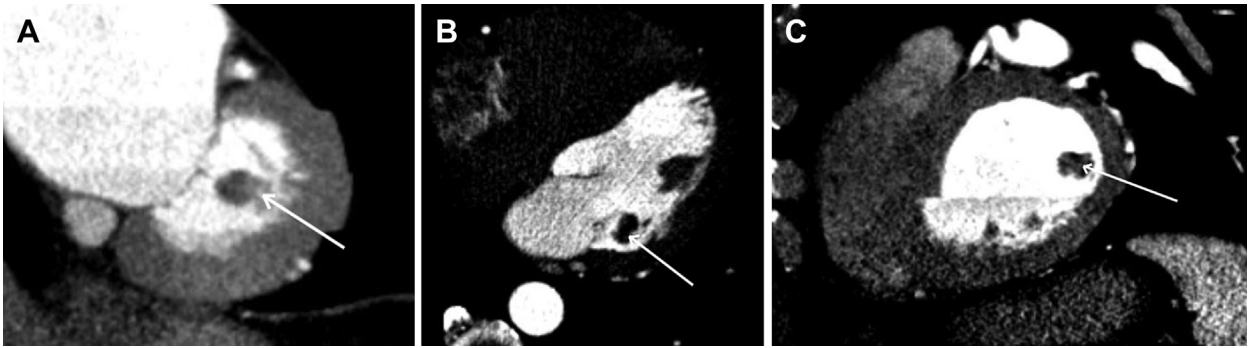


Figure 2 Nongated contrast-enhanced CT reconstructed in three-chamber (A), long-axis (B), and short-axis (C) planes demonstrating a mass abutting the left ventricular free wall just inferior to the posterior mitral valve annulus, which is hypodense to surrounding enhanced blood and isodense to the adjacent papillary muscle and normal myocardium. Arrows denote the location of the CPF.

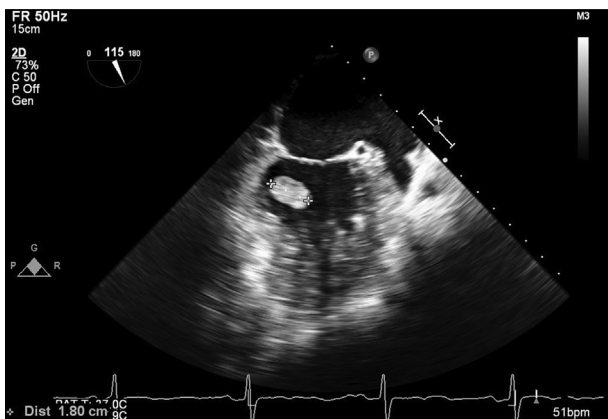


Figure 3 TEE revealed a mobile echodensity seen attached to the left ventricular myocardium, located immediately apical to the posterior mitral valve leaflet and measuring 1.8 cm in the largest dimension. See Videos 1 to 4.

superior in this regard. Despite the various cardiac imaging modalities used, the final diagnosis remained unknown until surgical resection was performed, because of the rare location and appearance of the tumor.

The sensitivity of TTE has been reported as 61.9% in cases with ≤ 20 -mm tumor dimension. Higher sensitivity is reached with TEE, including for smaller CPFs.⁶ For a more comprehensive and accurate assessment before surgery that defines localization as well as relationships with adjacent structures, a transesophageal approach should always follow the transthoracic one.¹ This highlights the overall superiority of TEE for examining small, mobile echodensities. Recently, three-dimensional TTE has also been successfully used in CPF diagnosis.¹³ When lesions appear to be unusual, the three primary cardiac imaging modalities (i.e., echocardiography, CT, and MRI) can be used together in a complementary manner for better characterization. Cardiac MRI can be useful in ascertaining signal characteristics but it can have difficulty in identifying points of attachment, which can be better assessed with electrocardiographically gated CT and TEE.¹⁴

In a meta-analysis of 725 CPF cases conducted in 2003, the authors postulated that tumor mobility was the only independent predictor of CPF-related death or nonfatal embolization.¹ However, a later study found that the echocardiographic characteristics of CPFs

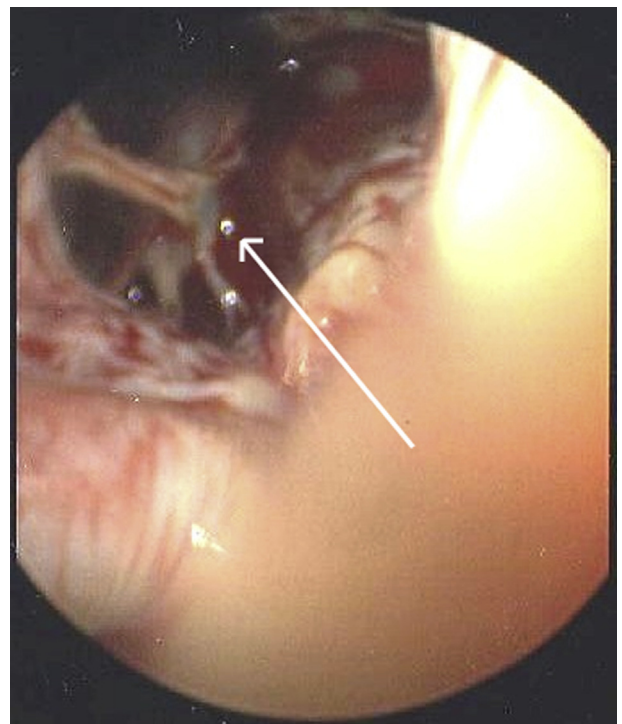


Figure 4 Intraoperative photo depicting a “sea anemone”-like fibroelastoma within the left ventricle. Arrow denotes the location of the CPF.

were not significantly associated with CVA.³ A third series could again not identify any imaging characteristics differentiating between the eight patients who presented with stroke and the 18 patients who were asymptomatic, except that the former were significantly younger (42 ± 17 vs 54.3 ± 18.4 years for the overall population).⁹

Once a CPF diagnosis is suspected, surgical excision is indicated for patients with relevant tumor-related symptoms, but it should also be considered in asymptomatic patients, particularly if they are young, and especially when large mobile tumors (>1 cm) are detected.^{1,9,15} Structural damage to the valves or broad-based adhesion of the tumor to leaflets may require valve repair or, in some cases, replacement. If possible, excision without repair or replacement should be pursued.¹² Evidence suggests that the risk for CVA is greater in patients with

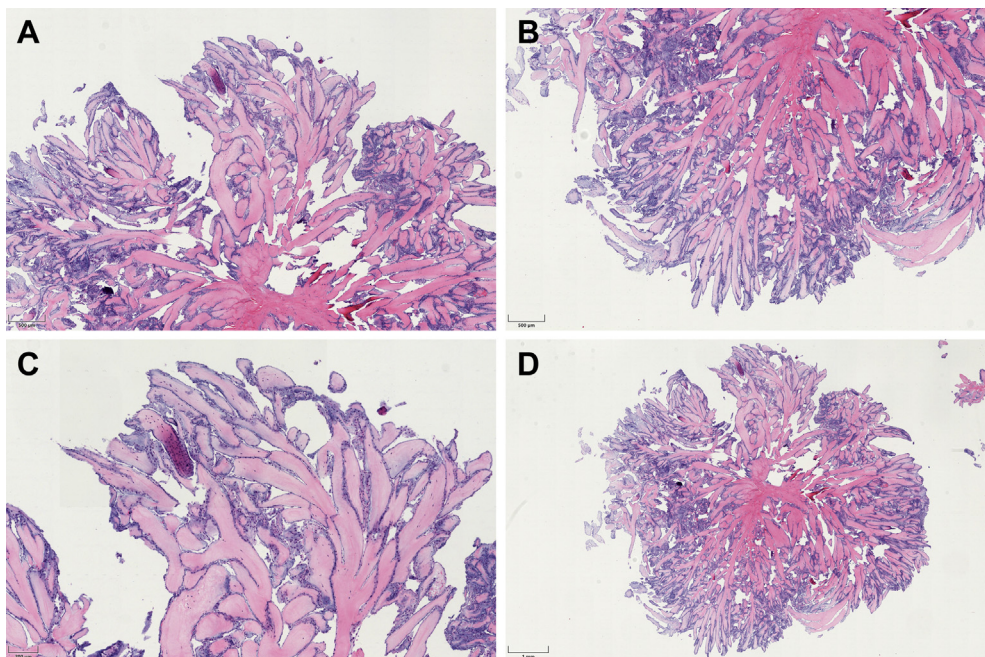


Figure 5 Histologic images (A–D) depicting avascular papillary fronds consisting of collagen lined by endothelial cells, consistent with CPF. The gross specimen (not shown) was reported as a white gelatinous mass measuring 1.5 × 1.2 × 0.8 cm.

echocardiography-identified but unoperated CPFs than in an age- and gender-matched population, and that excision substantially decreases CVA risk and even mortality from CPF.³

After resection, stroke recurrence rates are low, and survival rates are excellent.^{3,16,17} Although rare, CPF recurrence has been reported, which underscores the importance of follow-up with TTE.¹⁸ There is no consensus on appropriate anticoagulation management after resection; however, if surgery is not an option, anticoagulation is warranted for all patients with CPFs regardless of prior embolization in those whom anticoagulation is not contraindicated.¹⁰

CONCLUSION

This case highlights the difficulties and inaccuracies involved in the interpretation of diagnostic imaging to adequately define certain cardiac malignancies, such as CPFs. In our case, we can further deduce that the patient's exertional dyspnea and abnormal stress test findings, which notably improved with complete resection, were likely related to his CPF.

SUPPLEMENTARY DATA

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.case.2019.12.004>.

REFERENCES

1. Gowda RM, Khan IA, Nair CK, Mehta NJ, Vasavada BC, Sacchi TJ. Cardiac papillary fibroelastoma: a comprehensive analysis of 725 cases. *Am Heart J* 2003;146:404-10.
2. Reynen K. Frequency of primary tumors of the heart. *Am J Cardiol* 1996;77:107.
3. Tamin SS, Maleszewski JJ, Scott CG, Khan SK, Edwards WD, Bruce CJ, et al. Prognostic and bioepidemiologic implications of papillary fibroelastomas. *J Am Coll Cardiol* 2015;65:2420-9.
4. Sharma R, Golian M, Shah P, Jassal DS, Shaikh N. Multimodality cardiac imaging of a left ventricular papillary fibroelastoma: a case report. *BMC Res Notes* 2017;10:9.
5. Nowacka A, Rancati V, Roumy A, Monney P, Marcucci CE, Kirsch M. Multiple cardiac papillary fibroelastomas: are they really rare or underdiagnosed? *Heart Lung Circ* 2019;28:e83-5.
6. Mariscalco G, Bruno VD, Borsani P, Dominici C, Sala A. Papillary fibroelastoma: insight to a primary cardiac valve tumor. *J Card Surg* 2010;25:198-205.
7. Arikan AA, Omay O, Aydın F, Kanko M, Gür S, Derviş E, et al. Aortic valve replacement for papillary fibroelastoma. *J Card Surg* 2017;32:347-54.
8. Howard RA, Aldea GS, Shapira OM, Kasznica JM, Davidoff R. Papillary fibroelastoma: increasing recognition of a surgical disease. *Ann Thorac Surg* 1999;68:1881-5.
9. Sousa-Uva M, Cardim N. Cardiac papillary fibroelastoma: so small and yet so dangerous. *Rev Port Cardiol* 2018;37:987-9.
10. Bonavia L, Jackson J, Pui-Yee Law J, Yui M, Joshi D. Brainstem stroke caused by left atrial cardiac papillary fibroelastoma: an increasingly recognized rare cause of stroke. *Cardiovasc Pathol* 2019;40:65-7.
11. Yandrapalli S, Mehta B, Mondal P, Gupta T, Khattar P, Fallon J, et al. Cardiac papillary fibroelastoma: the need for a timely diagnosis. *World J Clin Cases* 2017;5:9-13.
12. Frederiksen CA, Eiskjær H, Poulsen SH. Two rare manifestations of cardiac papillary fibroelastoma presenting with dyspnea. *CASE (Phila)* 2018;2:123-6.
13. Le Tourneau T, Pouwels S, Gal B, Vincentelli A, Polge AS, Fayad G, et al. Assessment of papillary fibroelastomas with live three-dimensional trans-thoracic echocardiography. *Echocardiography* 2008;25:489-95.
14. Rahsepar AA, Ghasemiesfe A, Sawlani RN, Ferreira Botelho MP, Paintal AS, Tumer Y, et al. A papillary fibroelastoma involving aortic and pulmonary valves: findings on multimodality imaging. *Ann Thorac Surg* 2017;103:e75.

15. Hakim FA, Aryal MR, Pandit A, Pandit AA, Alegria JR, Kendall CB, et al. Papillary fibroelastoma of the pulmonary valve: a systematic review. *Echocardiography* 2014;31:234-40.
16. Sun JP, Asher CR, Yang XS. Clinical and echocardiographic characteristics of papillary fibroelastomas: a retrospective and prospective study in 162 patients. *ACC Curr J Rev* 2001;10:41-2.
17. Pacini D, Careddu L, Pantaleo A, Berretta P, Leone O, Marinelli G, et al. Primary benign cardiac tumours: long-term results. *Eur J Cardiothorac Surg* 2011;41:812-9.
18. Popovic C, Yong MS, Saxena P, Yadav S. Papillary fibroelastoma: a unique case of distant recurrence. *J Thorac Cardiovasc Surg* 2019;157:e125-7.