

CASE REPORT

BEGINNER

CLINICAL CASE

A Patent Foramen Ovale Grants Cardiac Output Over an Obstructive Primary Cardiac Lymphoma



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ABSTRACT

Primary cardiac lymphomas are extremely rare and involve mainly the pericardium. We present the case of a 77-year-old man with a germinal center diffuse large B-cell lymphoma causing severe right ventricular inflow obstruction. Clinical presentation of isolated dyspnea and severe desaturation and cyanosis were, otherwise, unexpected. (**Level of Difficulty: Beginner.**) (J Am Coll Cardiol Case Rep 2022;4:1353-1356) © 2022 Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

HISTORY OF PRESENTATION

A 77-year-old man presented at the emergency department with 1 week of worsening of exertional shortness of breath. He denied syncope, orthopnea, peripheral edema, cough, or fever. Physical examination findings were unremarkable apart from severe peripheral desaturation (oxygen saturation of 80% on room air) and central cyanosis.

LEARNING OBJECTIVES

- To emphasize the importance of comprehensive clinical and imaging correlation focused on patient complaints.
- To be aware of the differential diagnosis for cardiac masses, including rare tumors.
- To demonstrate the advantages of a multimodality imaging study and multidisciplinary therapeutic decision making.

PAST MEDICAL HISTORY

The patient had an history of systemic hypertension and a minor hemorrhagic stroke 4 years before without sequelae.

DIFFERENTIAL DIAGNOSIS

Given the isolated severe hypoxemia, pulmonary embolism (PE) was the main differential diagnosis considered. The lack of findings on pulmonary examination made other lung diseases less likely.

INVESTIGATIONS

Thoracic computed tomography (CT) coronary angiogram (angio-CT) scan ruled out PE and primary pulmonary diseases but showed a cardiac mass within the right cardiac chambers, which was confirmed with transthoracic echocardiogram. Cardiac magnetic resonance revealed a mass that infiltrated the

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ABBREVIATIONS AND ACRONYMS

angio-CT = computed tomography coronary angiogram
CT = computed tomography
PCL = primary cardiac lymphoma
PE = pulmonary embolism
PFO = patent foramen ovale
R-CHOP = rituximab, cyclophosphamide, doxorubicin, vincristine and prednisolone

tricuspid valve leaflets and was isointense on T1- and hyperintense on T2-weighted sequences, without loss of signal after fat suppression or enhancement on first-pass perfusion, and mild enhancement on late gadolinium enhancement images (**Figure 1**). Differential diagnosis included metastasis, sarcoma, or lymphoma. Better characterization by transesophageal echocardiogram showed a large, heterogeneous, lobulated mass without intrinsic flow by color Doppler that involved the right ventricle and atrium, was adherent to the tricuspid ring, and engulfed the anterior leaflet of the tricuspid valve. The mass caused significant obstruction of the right ventricular inflow because of extreme reduction of the tricuspid valvular orifice (**Video 1**), but no invasion of either the vena cava or right ventricular outflow tract was seen.

Overall, these ultrasonographic features did not correlate with the patient's clinical signs and symptoms because there were no signs of low cardiac output or even clinical or echocardiographic data of elevated right ventricular filling pressures, like peripheral edema, dilated inferior vena cava, or ascites (**Video 2**). However, the remaining echocardiographic study showed that the interatrial septum had a severe bulging to the left atrium with a "stretched" patent foramen ovale (PFO) that was persistently open throughout the cardiac cycle, causing a large continuous right-to-left shunt (**Video 3**). Ultimately, this was the cause of the patient's dyspnea, cyanosis, and severe peripheral desaturation, and the severe shunt explained the preserved cardiac output and normal venous systemic pressures.

MANAGEMENT

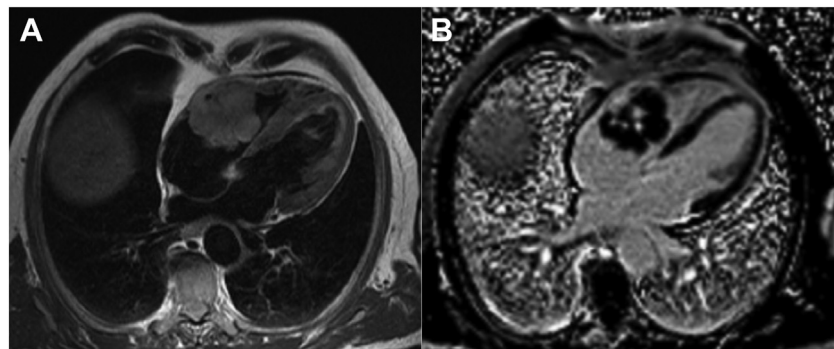
The patient was submitted to urgent cardiac surgery. A large mass of 80 × 50 mm was identified firmly adherent to the tricuspid annulus and base of right ventricular anterior wall; it had a lumpy and friable appearance, was yellowish, and was poorly vascularized. A partial recession was performed concerning preservation of right cavities' integrity, and tricuspid valve replacement with biological prostheses (Epic 31, Abbott) was performed. The PFO was additionally closed with stitches, and normal peripheral saturation was restored. The postoperative period had no complications, and the patient was transferred to his home-area hospital on the sixth postoperative day and remained on warfarin for 3 more months.

Histologic results revealed a germinal center diffuse large B-cell lymphoma with positive CD20, BCL2, and BCL6 and a median proliferative index (Ki67 expression) of 90%. A full-body ¹⁸fluorodeoxyglucose positron emission tomography/CT showed high uptake in the right heart chambers, in 2 small mediastinal lymphadenopathies, and in the L5 vertebral body (**Figure 2**). The patient was referred to a hemato-oncology consultation and started first-line chemotherapy with rituximab, cyclophosphamide, doxorubicin, vincristine and prednisolone (R-CHOP).

DISCUSSION

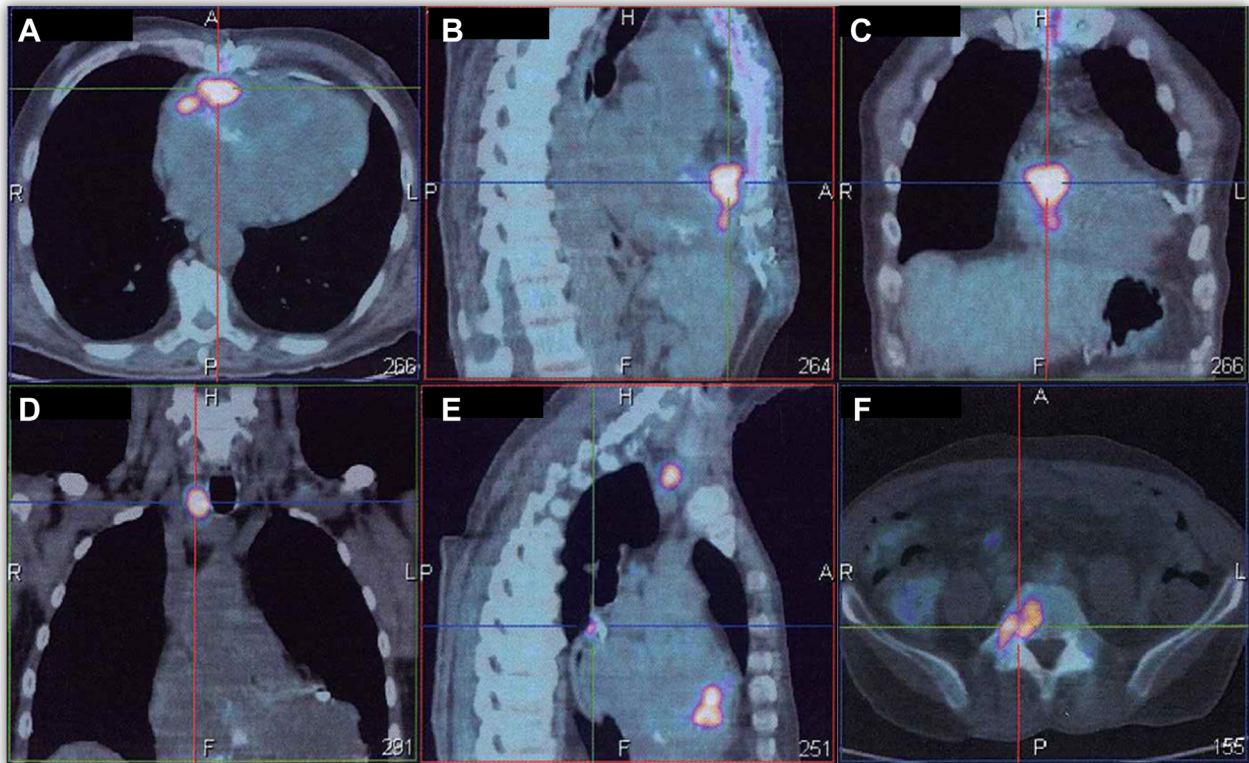
Primary cardiac lymphomas (PCLs) are extremely rare and affect mainly the pericardium or present as lymphomatous cardiac infiltration.¹ Here, we describe a rare case of primary cardiac germinal center diffuse

FIGURE 1 Cardiac Magnetic Resonance Study



Cardiac mass infiltrating tricuspid valve leaflets (**A**) isointense on black blood T1-weighted sequence and with (**B**) mild uptake on late gadolinium enhancement sequence.

FIGURE 2 ¹⁸Fluorodeoxyglucose Positron Emission Tomography/Computed Tomography Study



(A to C) Orthogonal computed tomography planes with high uptake in right cardiac chambers. **(D, E)** Right paratracheal and millimetric paraesophageal lymphadenopathies. **(F)** Uptake in the L5 vertebral body.

large B-cell lymphoma, presenting as a large obstructive mass and peculiar clinical manifestation.

A PCL is defined as a lymphoma involving only the heart and/or pericardium or an associated but not isolated extracardiac lesion that does not represent the bulk of the tumor.^{1,2} PCLs account for fewer than 1% of primary cardiac tumors, already very rare.^{1,2} They most often involve the right-sided cardiac chambers, mainly the right atria, and rarely arise from the tricuspid ring or leaflets.^{2,3}

The most common manifestations are dyspnea, although PCL can manifest with signs of heart failure, rhythm disturbances, or severe obstructive symptoms.^{2,3} This specific case was peculiar because, although presenting with a large mass obstructing right ventricular inflow, there were no matching complains of syncope or signs of venous systemic pressure elevation. A large PFO with right-to-left shunt, preserving left ventricular stroke volume at

the expense of venous admixture and consequent desaturation, could explain the clinical features of this case.

Imaging studies are crucial to the diagnosis workup of PLC. In this patient with isolated dyspnea, a thoracic angio-CT scan could exclude PE. Cardiac ultrasonography is the landmark for PCL diagnosis, with transthoracic echocardiogram having a sensitivity of 73% and 55% for right atrial and ventricular involvement, respectively.^{1,3} Especially in this patient, transesophageal echocardiogram was pivotal to identifying hemodynamic effects of the obstructive mass; establishing a comprehensive clinical and imaging correlation; and assessing the involvement of adjacent anatomic structures, essential to surgery planning.

Furthermore, the use of ¹⁸fluorodeoxyglucose positron emission tomography/CT was crucial in identifying the bulky lesion confined to the heart

and in stratifying for the presence of small extracardiac lesions.⁴ This is the first case describing mediastinal lymph nodes and vertebral body involvement.

Treatment of PLC involves chemotherapy with the R-CHOP protocol,⁵ which was applied to this patient with good tolerability. Concomitant surgery and/or radiotherapy have been reported to have no survival benefit,^{1,2} because complete resection is often technically challenging, as in this case. In fact, surgery was necessary in this patient to achieve an improvement in quality of life and control his symptoms.

Conflicting data exist concerning the prognosis of PCL, which has been traditionally associated with a poor prognosis and a median overall survival of 12 months,¹ especially if diagnosed late. However, chemotherapy has been associated with a better prognosis,⁶ with reports of median overall survival of 63 months² and an overall cure rate of 70% to 80% in the germinal center subtype of diffuse large B-cell lymphomas.⁷ Little is known about predictors of better outcome, but BCL2 positivity and high median proliferative index, presented by this patient, are associated with a high response rate to chemotherapy. However, the presence of extracardiac disease was associated with worse overall survival.¹

FOLLOW-UP

At the 18-month follow-up, the patient had no cardiovascular complaints. He completed the chemotherapy with 1 episode of febrile neutropenia, which was successfully managed. Further follow-up is needed to assess tumor response to treatment.

CONCLUSIONS

We present a rare case of PCL with an unusual presentation. This case nicely illustrates the need for a continuous critical clinical judgement, pursuing clinical and imaging correlation. In the presence of a very rare disease, systematic, critical, and multimodality evaluations are essential for the correct and complete diagnosis, as is a multidisciplinary assessment for a better long-term prognosis.

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The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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KEY WORDS patent foramen ovale, primary cardiac lymphoma, transesophageal echocardiogram

APPENDIX For supplemental videos, please see the online version of this paper.