Beyond Cardiac Tamponade: Detection of a Fulminant Mediastinal B-Cell Lymphoma with Cardiac and Coronary Involvement by Cardiac Magnetic Resonance

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Abstract

Mediastinal lymphomas with pericardial and cardiac involvement represent a rare but life-threatening clinical entity in which earlier diagnosis and treatment is critical. We report the case of a 40-year-old, previously healthy man who presented with acute dyspnea due to cardiac tamponade. Emergency echocardiography confirmed a large pericardial effusion requiring urgent pericardiocentesis. Despite initial stabilization, the patient developed chest pain with electrocardiographic changes suggestive of acute ischemia, prompting further investigation.

A comprehensive multimodality imaging approach was implemented. Cardiac magnetic resonance (CMR) provided a detailed anatomical assessment and tissue characterization, demonstrating a large anterior mediastinal mass with pericardial involvement, marked T2 hyperintensity, elevated native T1 and T2 mapping values, and heterogeneous late gadolinium enhancement. Importantly, CMR identified encasement and probable compression of the right coronary artery, explaining the ischemic presentation. Computed tomography confirmed the extent of disease and guided further biopsy.

Histopathology study confirmed a type of aggressive B-cell non-Hodgkin lymphoma. Despite a prompt diagnosis, the clinical course was rapidly progressive and fatal.

This case highlights the pivotal role of CMR as a non-invasive "virtual biopsy," enabling accurate diagnosis, assessment of disease extent, and early risk stratification in complex cardio-oncologic scenarios.

Introduction

Mediastinal tumors encompass a heterogeneous group of entities arising from or located within the central compartment of the thoracic cavity [1]. Although these lesions are relatively uncommon, with a reported prevalence ranging from 0.73% to 0.9%, their clinical presentation varies significantly, from asymptomatic incidentalomas to severe manifestations related to mass effect and invasion of adjacent mediastinal structures [2].

Among these, lymphomas represent one of the most frequent etiologies, particularly in a young patient population [2]. As the second most common group of tumors involving the anterior mediastinum, lymphomas include both Hodgkin and non-Hodgkin subtypes [3]. The classic lymphoma phenotype typically involves patients between 10 and 40 years of age, who may present with mild-to-moderate respiratory symptoms or remain asymptomatic despite rapid lesion growth and infiltration of mediastinal tissues [4].

Consequently, the integration of clinical data, patient's demographic characteristics with advanced imaging modalities constitutes the cornerstone of the diagnostic process, enabling a precise presumptive diagnosis in the majority of patients.

Specifically, cardiovascular involvement in mediastinal lymphomas can lead to life-threatening complications, where an acute clinical onset may be the first manifestation of the disease [5].

This case report highlights the clinical utility of cardiac magnetic resonance (CMR) in unraveling complex presentations of mediastinal lymphoma.

Case presentation

We report the case of a 40-year-old, previously healthy man who presented to the emergency department with a sudden onset of severe dyspnea, prompting urgent clinical evaluation. Initial bedside transthoracic echocardiography revealed a large circumferential pericardial effusion with features of cardiac tamponade, including chamber compression and impaired ventricular filling. Given the hemodynamic instability, emergent pericardiocentesis was performed, resulting in transient clinical improvement. Pericardial fluid was collected for diagnostic analysis, revealing exudate characteristics.

Despite initial stabilization, the clinical course evolved rapidly. The patient subsequently developed severe precordial chest pain accompanied by dynamic electrocardiographic changes suggestive of acute myocardial ischemia, raising concern for a more complex underlying process beyond isolated pericardial disease.

In this context, and under a working diagnosis of a possible myopericarditis, a comprehensive multimodality imaging strategy was initiated. Repeat transthoracic echocardiography, CMR, and contrast-enhanced thoracic computed tomography (CT) were performed to further clarify the etiology.

This integrated imaging approach proved decisive. Cross-sectional imaging revealed a large anterior mediastinal mass with direct pericardial involvement and cardiac compression, providing a unifying explanation for both the pericardial effusion and the evolving clinical presentation.

A CT-guided percutaneous biopsy of the mediastinal lesion was subsequently performed. Histopathological analysis confirmed an aggressive B-cell non-Hodgkin lymphoma involving the mediastinum and adjacent cardiovascular structures.

The patient was referred for specialized oncologic and hematologic management. However, despite early diagnostic clarification, the disease followed a fulminant course, culminating in rapid clinical deterioration and death.

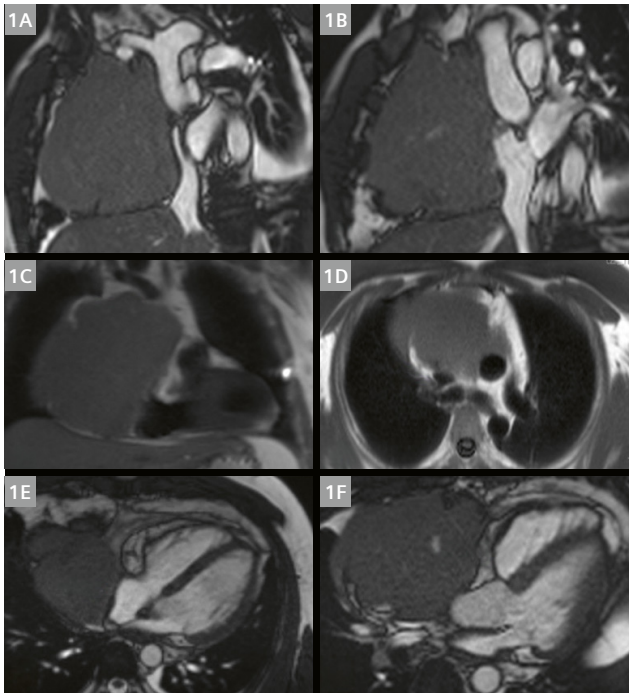
Imaging findings and CMR protocol

To evaluate the nature of the lesion and its hemodynamic impact, we followed a dedicated "cardiac tumor" multiparametric protocol:

- Anatomical assessment: High-resolution T1-weighted turbo spin-echo (TSE) and T2-weighted short tau inversion recovery (STIR) sequences to evaluate mass margins and signal intensity relative to the pericardium and myocardium.
- Tissue characterization: Quantitative T1 and T2 mapping were integrated to provide objective data on tissue composition, alongside fat-saturation techniques to rule out lipomatous infiltration.
- Functional imaging: Real-time (RT) Cine sequences during inspiration to assess for ventricular septal flattening, a key marker of pulsus paradoxus and right ventricular pressure overload.
- Vascular assessment and late gadolinium enhancement (LGE): Post-contrast late gadolinium enhancement to evaluate vascularization and tissue characterization.

Diagnostic and prognostic value of CMR

A large, heterogeneous mass, predominantly isointense to cardiac muscle on black-blood sequences, occupied almost the entire anterior-mid and right mediastinal region. There was a displacement of vascular structures, including the right brachiocephalic vein, and compression and partial obstruction of the superior vena cava (SVC) with displacement of the right cardiac chambers (Fig. 1).



1 This panel illustrates the comprehensive CMR approach for the evaluation of the mediastinal/cardiac mass: **(1A, 1B)** Localizer images axial views showing a large, lobulated mass with a maximum measurement of 11 x 9.8 cm. **(1C, 1D)**. There is a displacement and compression of the right brachiocephalic vein and the superior vena cava (SVC). Figures **(1E, 1F)** show displacement of the right atrium and right ventricle.

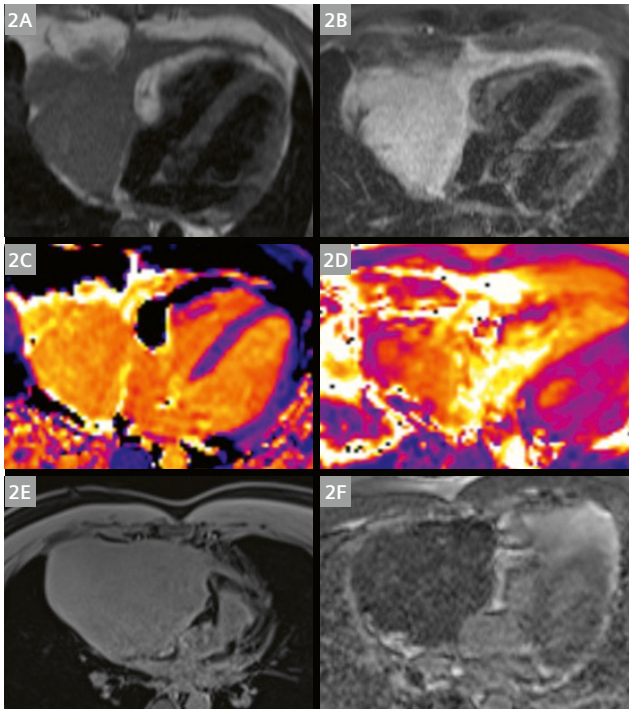
The pericardium was mildly thickened, with a maximum measurement of 5 mm. The CMR findings were pathognomonic for a highly cellular, inflammatory, and aggressive lesion. The mass appeared isointense on T1-weighted images but significantly hyperintense on T2 STIR, suggesting high water content or edema. Quantitative mapping confirmed these findings, with elevated native T1 values (1553 ms) and markedly increased T2 values (68 ms), suggesting a highly cellular and edematous malignant process (Fig. 2).

Of critical clinical importance was the vascular assessment. CMR revealed that the right coronary artery (RCA) was encased by the tumor, with evidence of extrinsic compression and probable occlusion of its mid-portion. This finding directly explained the patient's ischemic ECG changes and precordial pain post-pericardiocentesis (Fig. 3). Furthermore, despite preserved global ejection fraction, real-time Cine images demonstrated septal flattening during inspiration, confirming a persistent hemodynamic impact on the right heart, despite the initial drainage.

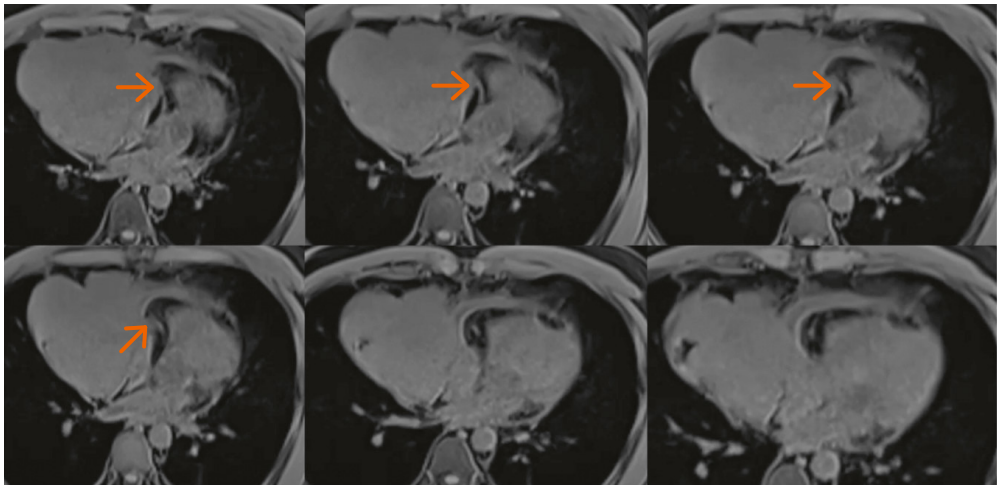
Discussion

The patient's initial presentation with sudden dyspnea and cardiac tamponade is an exceedingly rare primary manifestation of a non-Hodgkin lymphoma, specifically primary mediastinal B-cell lymphoma (PMBCL) [6].

Symptoms are variable depending on the location, impact of cardiac hemodynamic and heart function, for example right heart failure, arrythmia, chest pain, superior vena cava (SVC) syndrome, cardiac tamponade and pleural effusion [6].



2 CMR tissue characterization approach showing **(2A)** isointense signal on axial T1-weighted spin-echo image and; **(2B)** hyperintense on T2-weighted STIR images; **(2C)** T1 mapping value of the cardiac mass was slightly elevated, up to 1553 ms; **(2D)** markedly elevated T2 mapping up to 68 ms; **(2E)** absence of nulling of cardiac mass on fat-saturated T1 TSE imaging ruled out fat infiltration; **(2F)** heterogenous enhancement of the cardiac mass on late gadolinium enhancement (LGE) images. Images acquired at 1.5T.



3 T1-weighted image localizer stack showed that the right coronary artery (RCA) was encased by the tumor (orange arrows) with evidence of extrinsic compression and probable occlusion of its mid-portion.

While PMBCL typically presents with symptoms related to mass effect (such as cough, chest pain, and progressive dyspnea), pericardial effusion can be seen in around 50% of cases, but primary presentation with cardiac tamponade is very infrequent.

Furthermore, PMBCL predominantly affects women in their third or fourth decades of life; thus, its diagnosis in a 40-year-old male represents an uncommon clinical scenario [7].

In the management of cardiac and mediastinal masses, integrating various advanced imaging modalities provides a comprehensive evaluation that guides clinicians from the emergency setting to a definitive histological diagnosis [8]. CMR is the reference technique for cardiac tumor study with the ability to assess the location, extra-cardiac involvement, and impact on cardiac function [4, 5, 9].

Recognized as the non-invasive gold standard for tissue characterization of cardiac tumors, CMR differentiated the mass from surrounding structures and evaluated myocardial and pericardial infiltration. There are specific features on CMR that can suggest a primary lymphoma such as right atrium involvement, no evidence of necrosis, pericardial effusion, and pericardial infiltration, different from our clinical case [5].

For secondary cardiac lymphomas, CMR typically shows signal intensities that are isointense or hypointense on T1-weighted images and mildly hyperintense on T2-weighted images, due to high cellularity and tissue edema. Late gadolinium enhancement (LGE) enabled assessment of tissue heterogeneity and vascularity, supporting differentiation between viable tumor tissue and necrotic components [8].

The development of precordial chest pain and electrocardiographic changes suggestive of acute ischemia is a critical point of interest. Malignant mediastinal masses can mimic primary cardiac conditions through direct mass effect on coronary arteries or direct myocardial infiltration, simulating acute coronary syndromes or myopericarditis. CMR has a superior ability to evaluate myocardial inflammation and necrosis, allowing to exclude primary ischemic pathology in favor of an infiltrative oncologic etiology, such as in our clinical case [6].

This case underscores the importance of suspecting PMBCL in patients with unexplained tamponade, and of using advanced imaging for a swift and accurate diagnosis.

Conclusion

In this case, the diagnostic precision of CMR enabled a clear differentiation between primary cardiac pathology and extrinsic malignant compression. Although histopathology later confirmed non-Hodgkin lymphoma, CMR effectively acted as a non-invasive "virtual biopsy," providing immediate tissue characterization and a comprehensive anatomical roadmap for diagnosis and management.

From a prognostic standpoint, the degree of vascular encasement and the mapping values underscored the aggressive nature of the disease. The patient suffered a terminal decompensation, highlighting that in cases of mediastinal lymphoma with cardiac and pericardial debut, the CMR findings of vascular compromise and high mapping values are early markers of a poor clinical trajectory.

Teaching points

- Cardiac tamponade may represent an uncommon initial manifestation of mediastinal lymphoma and should prompt evaluation for underlying malignancy.
- Multimodality imaging is essential to move from emergency diagnosis to etiological clarification in complex cardio-oncologic presentations.
- CMR is the reference technique for cardiac tumor characterization, integrating morphology, function, and tissue composition in a single examination.
- Right ventricle involvement, pericardial effusion, and markedly elevated native T1 and T2 mapping values are key quantitative markers of malignant infiltration and tumor activity.
- Vascular encasement, particularly of coronary arteries, is a critical imaging finding that may explain ischemic presentations mimicking acute coronary syndromes.
- Real-time Cine imaging can reveal persistent hemodynamic compromise even after pericardial effusion drainage.
- CMR can function as a non-invasive "virtual biopsy," guiding diagnosis and clinical decision-making prior to histological confirmation.
- Imaging biomarkers of aggressiveness, such as extensive infiltration, high mapping values, and vascular involvement, are associated with poor prognosis.
- In cardio-oncology, early integration of advanced imaging is crucial for timely diagnosis, risk stratification, and management.

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