Multimodality Imaging Features of Cardiac Fungal Infection: A Case Report

Norain Talib, Yusri Mohammed,
Sharipah Intan S. SY. Abas, Kama Azira Awang Ramli

Department of Radiology, Hospital Serdang, Selangor, Malaysia

We present a 38-year-old man with hepatitis C and history of intravenous drug use who presented with fever and hemoptysis. Initial chest CT showed bronchiectasis with an intracavitary lesion consistent with invasive lung aspergillosis in the background of a previously treated tuberculosis infection. Subsequently, he developed cardiac failure symptoms, and transthoracic echocardiogram revealed a left ventricle (LV) apical lesion mimicking a thrombus or vegetation. However, cardiac MRI suggested a fungating apical lesion in the LV, which showed gradual enhancement at the peripheral lesion while sparing the central core in the first-pass perfusion sequence. The long inversion time (600 milliseconds) of the late gadolinium sequence confirmed presence of persistent peripheral enhancement suggestive of an infective focus rather than a thrombus. The intracardiac lesion was compatible with a left ventricular fungal lesion or aspergilloma consistent with a positive serum galactomannan assay. The patient refused surgical intervention. Despite a long course of antifungal therapy, he succumbed to death three weeks after completion of treatment due to disease complications.

Key words Cardiac aspergilloma · Magnetic resonance · Computer tomography · Echocardiography.

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Corresponding author

Norain Talib, MRad
Department of Radiology,
Hospital Serdang, Jalan Puchong,
43000 Kajang, Selangor, Malaysia
Tel: 60-3-8947-5555
Fax: 60-3-8947-5050
E-mail: saa2707y@gmail.com

INTRODUCTION

Infectious disease of the heart generally involves endocardium, myocardium, valvular structures, or pericardium and results from various sources, including fungus, although this source is the least common [1]. Cardiac fungal infection commonly results from direct or indirect exposure, through objects such as cardiac instrumentation/catheterization or hematogenous spread, predominantly among high-risk or vulnerable populations, such as the elderly and intravenous drug users. Furthermore, pre-existing comorbidities that complicate the complexity and severity of patient morbidity prior to cardiac manifestation complicate diagnosis. Therefore, multimodality imaging is important in assisting diagnosis. Two-dimensional (2D) or three-dimensional (3D) echocardiography is the primary imaging baseline assessment, while CT and MRI are the choice of investigation for further characterization of the lesion. In this case report, we describe the multimodality imaging features of fungal disease

of the heart in a young, immunocompromised patient.

CASE REPORT

A 38-year-old patient was referred from a primary hospital to our institution with complaints of hemoptysis, fever, and bilateral pedal edema. He had been diagnosed with hepatitis C in April 2019, had history of treatment for pulmonary tuberculosis and intravenous drug use, and a former chronic smoker. He had been treated with syrup methadone for his addiction.

Clinically, he appeared well, was pink on continuous low oxygen support but was not tachypneic, and was non-tachycardic with normal blood pressure. Lung auscultation revealed bronchial breath sounds with generalized lung crepitations. The patient had normal heart sounds and normal apex beats. No additional heart sounds were noted.

Chest radiograph revealed scattered calcific lung nodules. Contrast CT (SIEMENS Somatom multidetector 64-slice CT) of the chest detected intracavitary lesions with calcifications in the background of bronchiectatic lung, consistent with invasive lung aspergillosis (Fig. 1). There was associated mucus plug-

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ging and an air fluid level within the bronchiectatic lung. Retrospectively, there was a subendocardial hypodense area overlying the apical wall of the left ventricle (LV), which was not initially reported (Fig. 1D). Clinically, the patient reported no chest pain, and his electrocardiogram was normal (information not shown).

Transthoracic echocardiogram was performed to rule out congestive heart disease one month after the initial chest CT. The LV ejection fraction was 55% with regional wall motion abnormality. There was a well-defined apical pedunculated echogenic lesion in the left ventricle measuring 2.9×1.6 cm (Fig. 2F), and the initial impression was vegetation rather than thrombus.

A 1.5 Tesla cardiac MRI (Magnetom Symphony, Siemens Healthineers, Erlangen, Germany) was performed at our institution (Fig. 2A-E) to further characterize the lesion. Imaging showed a well-defined, irregular, left ventricle apical lesion (measuring approximately 2.4–3.1 cm²), which returned an isointense signal of the myocardium on T1-weighted, T2-weighted, and turbo inversion recovery magnitude. In steady-state-free-precession imaging, this lesion revealed central hyperintensity. Peripheral enhancement was seen in the contrast-enhanced first-pass perfusion but not in the central core. Persistent peripheral enhancement was also noted in the long inversion time se-

quence at 600 milliseconds, suggestive of an infective focus consistent with a fungal lesion.

Hematological investigations showed leukocytosis ($21.4 \times 10^3/\mu\text{L}$) with a normal hemoglobin level and platelet count. Tuberculosis work up was negative. The second blood culture study was unremarkable. An enzyme immunoassay for serum aspergillus galactomannan antigen was positive at 0.96 (a positive result means index equal to or greater than 0.5). Therefore, anti-fungal amphotericin B and variconazole with potassium mist were initiated, and the patient was advised to undergo surgical removal of the cardiac lesion. However, he refused further surgical intervention and was discharged from the hospital at his own risk. He was prescribed itraconazole 200 mg twice daily for 6 weeks. However, he succumbed to death at home 3 weeks after discharge due to multiple complications.

DISCUSSION

Invasive fungal disease of the heart is a rare entity that usually occurs among immunosuppressed patients and is particularly difficult to diagnose and manage. Fungal infection commonly occurs in the lungs and/or sinuses and may be disseminated via hematogenous spread [2]. Although it is a rare occurrence and

Fig. 1. Chest CT of a 38-year-old man with cardiac aspergilloma. Serial, selective, axial-view chest CT images in lung and mediastinal windows, respectively, were performed one month prior to echocardiography and cardiac MRI. A: An intracavitary lesion (blue arrow) consistent with invasive lung aspergilloma. B: Calcification can be seen within the lesion (blue arrow). C: The patient had a history of bronchiectasis associated with mucus plugging, air-fluid level, and mosaic attenuation of lung parenchyma. D: On coronal view, ill-defined hypodensity was visible in the apical left ventricle wall; no fungating mass was seen (red arrow).

Fig. 2. Cardiac MRI of a 38-year-old man with cardiac aspergilloma. Images show short axis views (A and B), a two-chamber view (C), and four-chamber views (D and E) and show an apical lesion (red arrows) arising from the LV wall. This lesion returns a central, hyperintense signal in cine steady-state-free-precession (A) and peripheral enhancement in the longer inversion recovery of the late gadolinium sequence at 600 milliseconds (B and C). Gradual peripheral enhancement was seen in the early phase of the first-pass perfusion study but spared the central core in the delayed phase (D and E). An echocardiogram (F) demonstrated an echogenic pedunculated lesion arising from the apical LV. LV: left ventricle.

has previously only been reported in autopsy studies, there are increasing series of cases in patients with permanent placement of central venous lines, parenteral feeding, prosthetic valve implantation, or multiple antineoplastic drug use, among others [3]. Commonly, fungal heart infection presents with native valve endocarditis [4], endocarditis, or cardiac device-related infection. Some present as a mass-like lesion on the cannulation side, leading to a lesional thrombus [5]. The widespread nature of fungal infections is responsible for the high morbidity and mortality seen in this condition. Therefore, early recognition, long-term antifungal therapy, and surgical intervention are likely to improve patient outcomes [2].

In the past few decades, several cases have been reported due to the availability of multimodality diagnostic imaging approaches, such as echocardiography, CT, and MRI. In 2004, a left ventricle pedunculated mass was reported in a 12-year-old Spanish girl with underlying acute lymphoblastic leukemia that had been detected on echocardiogram and was confirmed to be a fungal vegetation at surgery [3]. A 61-year-old from the United States (US) developed chronic necrotizing pulmonary aspergillosis complicated by intracavitary extension into the heart with subsequent widespread micro- and macroembolization [6]. Multimodality imaging findings of 4 cases of invasive fungal disease of the heart among immunosuppressed young

adults ranging from 26–33 years old were reported in Boston, Massachusetts, in the US in 2017 [4]. In the United Kingdom, a 60-year-old with leukemia developed a graft-versus-host reaction culminating in fungal chest infection with a large nodular lesion in the left ventricular outflow tract that was detected during chest CT; cardiac MRI revealed multifocal intramyocardial lesions consistent with invasive aspergillosis.

A histopathological study was not performed in our case because of patient refusal for surgical intervention. Nevertheless, there were several findings that suggested cardiac fungal infection. The patient had history of hepatitis B and intravenous drug use; his blood culture and serum galactomannan assays were both positive. In addition to these strong clinical indicators of cardiac fungal infection [1], evidence of invasive lung aspergillosis supported disease dissemination, as in previous case studies [4,7].

On imaging, fungal heart disease is difficult to differentiate from a thrombus or tumors due to common imaging findings. However, popular multimodality imaging combinations can aid in diagnosis. Most reported studies have stated the importance of echocardiography alone in diagnosis [2,5,7]. In addition, 2D or 3D echocardiogram technology is useful for assessing mass dimension and nature as well as surrounding structures due to its high resolution. Echocardiography has some limitations as

a screening tool, including a restricted field of view and an incomplete ability to characterize mass. Multiplanar, non-operative-dependent studies are an important complementary modality of choice, namely CT and cardiac MRI, to offer further lesion characterization and better temporal and spatial resolution, respectively.

According to DeFilippis et al. [4] and Paul et al. [7], fungal infections do not show robust central perfusion on cardiac MRI (a feature of many malignant masses); instead, they often demonstrate delayed peripheral enhancement around the mass, a non-specific feature that is suggestive of an infectious cause. Some existing studies have presented similar findings. Late gadolinium-enhanced imaging using a long inversion time of 600 milliseconds is preferred to detect a thrombus in appropriate cardiac locations. Using this technique, the thrombus is characteristically dark because of its long T1 characteristic [8]. Based upon these features, a thrombus diagnosis in our patient was excluded. Additionally, in our study, infective features were confirmed whereby there was peripheral enhancement during the first-pass perfusion and longer inversion time of the late gadolinium phase showed central core sparing of lesion.

Our case showed atypical hypodensity in the left ventricular wall at the apical region on chest CT one month prior to echocardiogram and cardiac MRI, suggestive of myocardium involvement based on variable degree of disease invasion of the endocardium, epicardium, or pericardium [7]. Cardiac MRI revealed a pedunculated lesion with peripheral enhancement, which indicated disease progression. Fungal thromboemboli with microabscess formation is another manifestation of cardiac fungal disease. These thromboemboli may be disseminated to cardiac ventricular walls, lung, liver, spleen, pancreas, kidneys, and gastric submucosa, as reported by Berarducci et al. [6]. Most patients present with fever and evidence of embolic phenomena, as in our case, which initially presented as invasive lung aspergillosis.

In conclusion, multimodality imaging findings are important in definitive diagnosis of aspergillosis. A high degree of clinical suspicion is also necessary, although a pathological examination was not performed in our patient. Early diagnosis and prompt management are required to improve patient outcomes from this fatal disease.

Conflicts of Interest

The authors have no potential conflicts of interest to disclose.

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