

## A Case Report on Primary Cardiac Non-Hodgkin's Lymphoma: An Approach by Magnetic Resonance and Thallium-201 Imaging

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### INTRODUCTION

Few cases of malignant cardiac lymphoma have been documented (1–3). We recently treated a patient who developed a primary cardiac non-Hodgkin's lymphoma that was clearly visible. Treatment was conducted through noninvasive imaging such as two-dimensional echocardiography, thallium-201 myocardial imaging, and magnetic resonance imaging (MRI) of the heart. MRI revealed particularly interesting findings that can be used for earlier diagnosis of this rare disease. We successfully removed the intracardiac malignant lymphoma, and the patient responded well to the subsequent radiation therapy. We compare this case of malignant cardiac lymphoma and clear MRI with earlier related literature.

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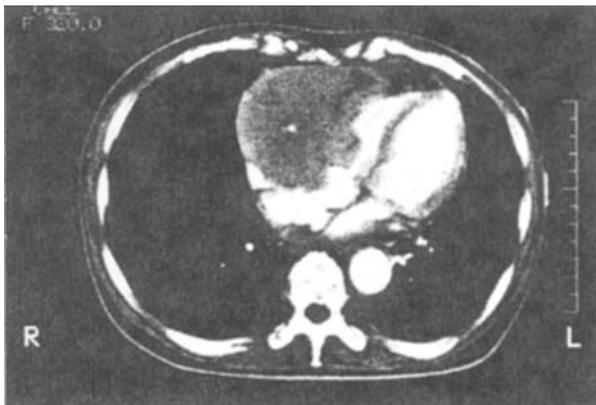
### CASE REPORT

A 60-year-old woman was admitted to the National Defense Medical College Hospital on October 25, 1994 because of palpitation that was especially prevalent on exertion. There was a history of weight loss (5 kg lost during 4 months). The patient had no history of cancer or hematologic disorders. Her sister had breast and tongue cancer. The patient's remaining past history and family history was unremarkable. Physical examination disclosed an alert and lean woman. Her weight and height were 49 kg and 150 cm, respectively. The body temperature was 37.4°C, the blood pressure was 130/90 mm Hg, and the pulse rate was 140 beats/min. Her jugular vein was distended both at the supine and 45-degree sitting position. A Levine's grade 2 systolic and diastolic mur-

mur was audible in the fifth intercostal space. Respiratory sound was clear. The liver was felt 4 cm below the costal margin on the right midclavicular line. There was no peripheral edema and no lymphadenopathy. Other physical examinations were essentially normal. Her neurologic examinations were within normal limits.

Electrocardiogram recorded on admission showed a ventricular tachycardia of left bundle branch block pattern and a ventricular tachycardia converted to sinus rhythm after intravenous administration of 50 mg mexiletine hydrochloride. Her electrocardiogram in sinus rhythm showed ST segment elevation in lead  $V_1$  and exaggerated P wave in leads II, III, and aVF, suggesting a right atrial volume overload. A chest x-ray showed cardiomegaly (cardiothoracic ration 59%). Laboratory tests revealed the following. The hemoglobin level was 12.6 g/dl and the white blood count was 4200/mm<sup>3</sup> and contained 65% neutrophils and 30% lymphocyte. The erythrocyte sedimentation rate was 38 mm/hr. Liver function tests were within normal limits. Cardiac enzymes showed a normal creatine phosphokinase level of 51 U/l (normal range, 0–160 U/l) and lactic dehydrogenase of 500 U/l (normal range, 100–225 U/l). The other laboratory tests were within normal limits.

A two-dimensional echocardiography showed a movable tumor in the right atrium and a large tumor in the right ventricle with mild pericardial effusion. The tumor was herniated through the tricuspid valve and was almost occlusive (Fig. 1). Computed tomography of the chest and abdomen confirmed that the tumor, sized 10.0 × 7.5 cm, originated from the right ventricle (Fig. 2). The tumor did not invade surrounding organs. No abnormal mediastinal lymph nodes were detected. A myocardial scan



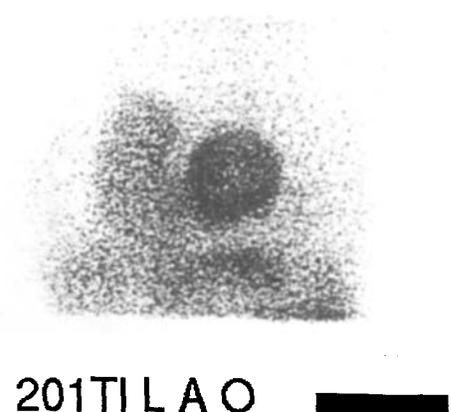
**Figure 1.** Transesophageal two-dimensional echocardiographic images. The intracavitary tumor was positioned in the right atrium and ventricle, protruding into tricuspid valve.



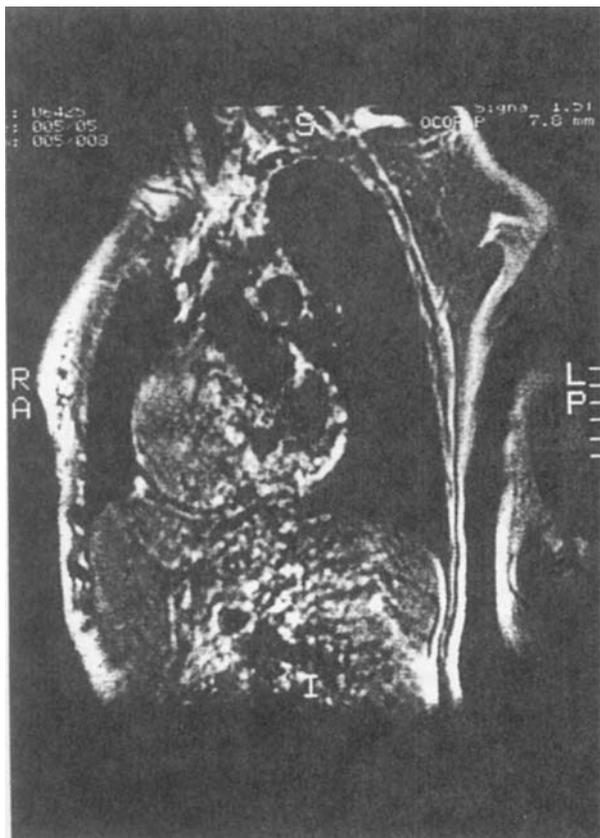
**Figure 2.** Computed tomography of the chest showing the tumor sized 10.0 × 7.5 cm in the right ventricle. No invasion to surrounding organs was confirmed, and no abnormal mediastinal lymph nodes were detected.

was performed at both 15 min and 4 hr after injection of thallium-201. The myocardial scan showed the isotope uptake into the tumor of the right ventricle in both early and delayed images (Fig. 3).

MRI was performed on 1.5-T superconducting magnet unit. T1-weighted spin-echo sagittal images (TR 400/TE 13) showed a bulky tumor in the right ventricular wall, sized 10.0 × 7.0 cm. The border of the solid tumor was unclear. The tumor was located at the anteromedial right ventricular free wall and had no evidence of invasion into surrounding organs (Fig. 4). T1-weighted spin-echo axial images of the tumor showed isointensity to slightly higher signal intensity compared with either cardiac or



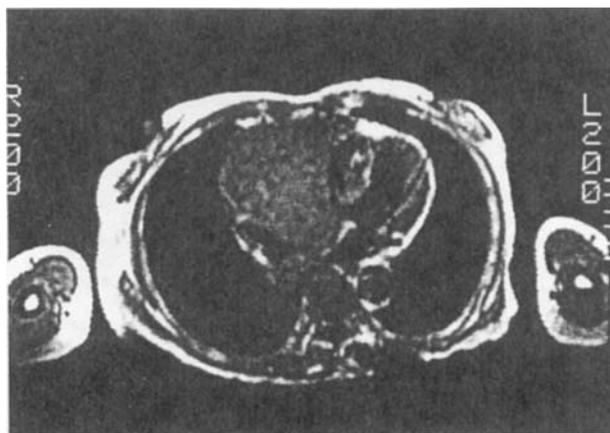
**Figure 3.** The imaging of thallium-201 myocardial scintigraphy. The myocardial scan showed the isotope uptake into the right ventricular cavity.



**Figure 4.** MRI of the heart showing the sagittal view of T1-weighted spin-echo (400/13). No evidence of invasion into surrounding organs was noted.

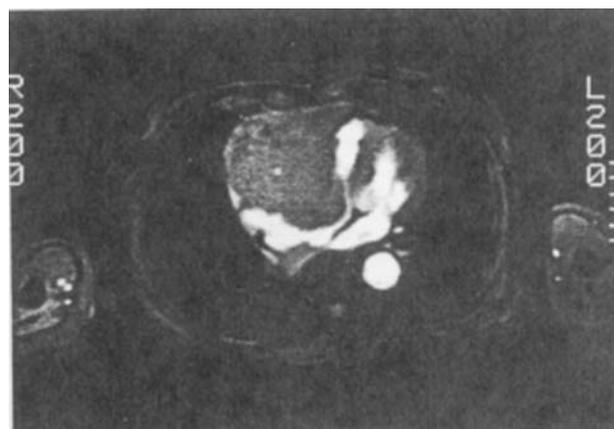
skeletal muscle (Fig. 5). The gradient-echo cine phase contrast images (TR 25/TE 7.2) demonstrated a right coronary artery penetrating the tumor in the right ventricle. Remarkable tricuspid stenosis made by the intracavitary tumor was noted (Fig. 6).

The clinical course after admission was as follows. Right cardiac catheterization was performed after 13 days of admission, which showed 13 mm Hg of pressure gradient between the right atrium and ventricle probably due to obstruction by the protruding tumor in the right atrium. Her right coronary angiogram showed tumor-feeding vessels without tumor stain. Left ventriculogram revealed a normal function. The venography showed a filling defect in the right atrium and irregularity of the right ventricle (Fig. 7). A movable tumor was detected around the tricuspid valve area. The patient underwent surgical resection of the tumor on November 8, 1994 to prevent the obstruction of the tricuspid valve area and pulmonary embolism by the tumor. Macroscopic findings in the operating room disclosed a large elastic hard tumor of about

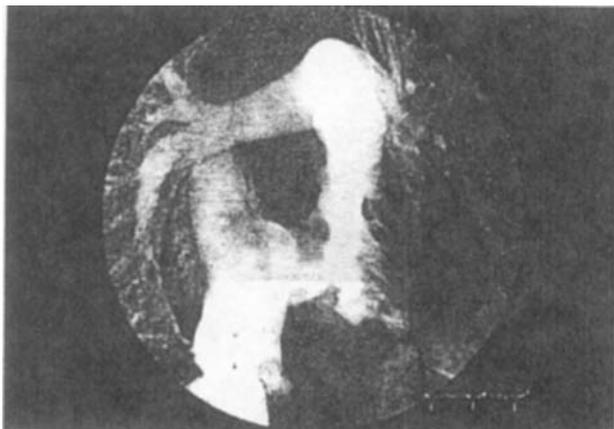


**Figure 5.** MRI of the heart showing the axial view of T1-weighted spin-echo (400/11).

10 cm in diameter that compressed the upper part of the right atrium and the apex of the right ventricle. There was a moderate amount of translucent pericardial brown-colored effusion. The tumor was thought to have developed from the right ventricular free wall and grown into the pericardium. The movable tumor was also attached near the anterior leaflet of the tricuspid valve and nearly occluded the tricuspid valve. The basal wall of the right ventricular was replaced by the tumor, but the tricuspid valve, papillary muscle, and intraventricular septum were not invaded. The movable tumor in the right atrium was resected. However, the tumor could not be resected totally, and the pericardial patch was partially sutured with the remaining tumor.



**Figure 6.** MRI of the heart showing the axial view of cine-phase contrast (25/7.2). The right coronary artery in the tumor was demonstrated, and remarkable tricuspid stenosis was noted.



**Figure 7.** Venography of the cardiovascular system showed a filling defect in the right heart (see text).

On histologic examination, the frozen resected specimen from the tumor revealed a diffuse proliferation of small atypical lymphoid cells with ovoid, slightly irregular, and hyperchromatic nuclei. Scattered mitotic activity was noted. The atypical cells infiltrated the bundles of cardiac muscle fibers, and partial necrosis lesions were observed in the cardiac muscle fibers. Immunohistochemistry demonstrated that the cells expressed leukocyte common antigen, and the cells reacted with L26, which is a reliable B-cell marker in paraffin section. These histologic features were characteristic of a malignant lymphoma with a diffuse small cell type and B lineage. Three weeks after surgery, the gallium scintigraphic study revealed an uptake of isotope in the remaining tumor of the right ventricle. Seven weeks after the surgery, the patient complained of an appetite loss. Two-dimensional echocardiography revealed a local increase of the tumor. She developed a right-sided heart failure and complained of shortness of breath and orthopnea at this time. Because of these symptoms, radiation therapy was conducted. After the radiation therapy, there was a remarkable decrease in the tumor size concomitantly with a reduction in subjective complaints. Chemotherapy (CHOP regimen: cyclophosphamide, doxorubicin, vincristine, and prednisolone) was undertaken to further prevent recurrence. Three months later, the patient had no symptoms and was able to engage in normal daily activities.

## DISCUSSION

Tumors of the heart are rare; incidence at autopsy ranges from 0.0017 to 0.03%. Such tumors are often left

untreated and frequently diagnosed postmortem (1–4). Approximately 75% of primary cardiac tumors are benign and the remaining 25% are malignant (1,2). Among them, primary cardiac lymphoma is extremely rare. Only 35 cases have been documented since 1960. This accounts for only 5.6% of primary malignant tumors of the heart (1,2). The most frequent cardiac complication coinciding with lymphoma appears to be pericardium. Intracardiac involvement is the least common and is frequently associated with acquired immunodeficiency syndrome or other immunocompromised hosts, mostly non-Hodgkin's lymphomas (5,6). Such lymphomas are usually high-grade small noncleaved cell (Burkitt-like) and large-cell immunoblastic plasmacytoid lymphomas, which account for 62% of the total cases. Twenty-nine percent are intermediate grade and remaining 7% are low grade (7).

The present case did not involve immunodeficiency syndromes or an immunocompromised state. Cardiac lymphoma in this case was primary, which is quite rare. Although the final diagnosis of the case was made at the time of the surgical resection, the several diagnostic procedures were useful in predicting the presence of the cardiac tumor. Hemodynamic study is useful because the findings of restrictive physiology of hemodynamics, associated with extensive tumor infiltration, may predict a poor prognosis (8).

Recently, MRI is used for cardiac investigation because it allows improved delineation of the relationship of intracavitary tumors compared with normal structures and is considerably better than echocardiography (9). MRI could give us relevant location of the tumor and the relation of the tumor to the right coronary artery. These data were very useful in preparing for surgical resection. In general, the signal intensity in MRI depends on tissue proton density and proton characteristics termed magnetic relaxation times T1 and T2. Relaxation times of neoplastic tissue are generally altered, allowing distinction from normal tissue, although the specificity for the pathologic diagnosis is limited (9,10). Intracardiac tumor was clearly visible through MRI in our patient, as shown in Figs. 4–6. Although T2-weighted images were not obtained in this case, most primary muscle lymphoma shows attenuated intensity on T1-weighted images and accentuated intensity on T2-weighted images (10,11). Negendank et al. (12) observed that lymphomas generally appeared hyperintense relative to muscle and isointense to slightly hyperintense relative to fat tissue on T2-weighted images. The T2-weighted images should be obtained if the intracardiac tumor is suspected. Most renal or primary central nervous system lymphoma was reported to be enhanced after administration of contrast

material (13,14). We did not enhance the tumor by use of contrast material such as gadolinium-diethylenetriaminopentaacetic acid so that the effect of contrast medium over the imaging of cardiac lymphoma is unknown. However, previous reports might suggest that the characteristics of the T1- and T2-weighted and enhanced images with the contrast medium are effective for diagnostic investigation and therapeutic follow-up, such as detection for a size of tumor or local recurrence.

The method is a significant improvement over present intracardiac lymphoma diagnoses. Reports of thallium-201 myocardial scintigraphy or other isotope images with cardiac malignant lymphoma were not found in the literature to the best of our knowledge. The B-cell lymphoma in the right heart was reported to have a feeding artery from the right coronary artery (15). Our patient showed an uptake of isotope in the tumor. This indicates that the primary cardiac lymphoma was supplied with a sufficient blood flow.

Most primary lymphomas of the heart are acute in the onset and short in duration (1,16,17). Radiation therapy is an important therapeutic option, and the results are especially promising for radiosensitive tumors such as leukemia and lymphomas (18). The present tumor was projected to be radiosensitive, and thus we started radiation therapy. The patient's complaints concerning shortness of breath and dyspnea disappeared. If the detection of a tumor is late, the tumor can obstruct the tricuspid valve. In this case, surgical resection of the tumor might be difficult. However, in the present case, numerous methods such as echocardiography, MRI, and MR angiography were used to detect the tumor in the cardiac cavities, which partly invaded the myocardium.

MRI was found to be extremely effective in the diagnosis of primary cardiac non-Hodgkin's lymphoma. We conclude that the cardiac complications due to lymphoma should be diagnosed primary through MRI. This allows early detection that enables effective therapeutic options that cannot be undertaken if diagnosis is delayed.

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