








# Difficulties in Differentiating Cardiac Lymphoma and Metastasis Based on Radiologic Features: Two Case Reports

영상 소견으로 감별이 어려운 원발성 심장 림프종과 심장 전이암: 2예 보고

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Cardiac tumors are rare diseases with various imaging findings. However, differentiating cardiac tumors based on imaging findings is challenging because of similarities in imaging features. We present two cases of cardiac tumors, including primary cardiac lymphoma and cardiac metastasis, in which the differential diagnosis was difficult.

**Index terms** Cardiac Tumor; Lymphoma; Metastasis; Computed Tomography, X-Ray; Magnetic Resonance

## INTRODUCTION

Primary cardiac tumors are rare, reported at less than 0.1% in a large series of 12000 autopsies (1). Among them, primary cardiac lymphoma is extremely rare, with a reported incidence of 0.15% to 1%, and accounts for 0.5% of all extranodal lymphoma (2, 3). Diffuse large B cell lymphoma is the most common histological type of primary cardiac lymphoma. Primary cardiac lymphoma is a rapidly growing, fatal tumor unless it is treated promptly (4). Cardiac lymphoma most commonly presents on the right side of the heart, particularly at the right atrium. It usually presents as an ill-defined, infiltrative mass in the myocardium with pericardial effusion (5). Metastatic cardiac tumors are approximately 30 times more prevalent than primary cardiac tumors, with less than

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a 1% incidence (6). Metastases can originate from any malignant tumor, but most commonly result from lung cancer, breast cancer, melanoma, and hematologic malignancies such as lymphoma and leukemia (7). The imaging findings of cardiac metastases may differ according to the primary tumor, but mostly present as infiltrative, heterogeneously enhancing, multiple pericardial masses involving the right heart and atria with pericardial effusion.

However, with the known radiologic imaging findings and clinical manifestations regarding cardiac tumors including cardiac lymphoma and metastasis, the radiologic differential diagnosis is still challenging in practice. In the present study, we present our experience with two cases of cardiac lymphoma and metastasis that showed similar locations and radiologic findings on transthoracic echocardiography (TTE), CT, PET/CT scans, and cardiac MR imaging.

## CASE REPORT

### CASE 1. CARDIAC LYMPHOMA

A 56-year-old male presented with anorexia, edema in both lower legs, dyspnea, and weight loss for three weeks before hospitalization. Pitting edema was observed during the initial physical examination. The laboratory findings were unremarkable except for elevated N-terminal-pro B-type natriuretic peptide (NT-proBNP) levels (1317 pg/mL; normal 232–314 pg/mL) and liver enzymes including alanine aminotransaminase (51 U/L; normal 8–42 U/L) and alkaline phosphatase (182 U/L; normal 30–130 U/L). On the day of hospitalization, complete atrioventricular dissociation was noted in the electrocardiogram. A large amount of pericardial effusion and a 2 cm-sized echogenic mass-like lesion was observed in the epicardial area, extending to the interatrial septum on TTE. On chest CT, a heterogeneously enhancing, infiltrative soft tissue mass was observed to be located at the right atrioventricular groove (Fig. 1A). The mass encased the right coronary artery (RCA) and left circumferential artery without luminal narrowing. Also, a large amount of pericardial effusion was noted. For further evaluation of the extent and features of the soft tissue mass, a cardiac MRI was performed. The cardiac MRI, showed a diffuse infiltrative, multi-nodular mass at the right atrioventricular groove around the RCA with an extension to the inferior atrioventricular groove. The lesions demonstrated iso-signal intensity on turbo spin-echo T1 and subtle high-signal intensity on short tau inversion recovery T2 weighted images (Fig. 1B). On the delayed enhancement images, heterogeneous enhancement with multifocal inner nodular low-signal foci of all lesions were noted (Fig. 1C). With the infiltrative multi-nodular appearances on cardiac MR, we considered cardiac metastases as the first impression rather than primary cardiac lymphoma. However, no primary malignancy or systemic metastatic lesion was found on chest CT, abdominal CT, or PET/CT (Fig. 1D). Pericardiocentesis with pericardial analysis and intracardiac echocardiography-guided biopsy were performed. Nonspecific atypical cells were found in the cytological analysis of the fluid. High-grade B-cell lymphoma, consistent with diffuse large B-cell lymphoma was confirmed through the biopsy (Fig. 1E). In immunohistochemical analysis, B cell markers CD20 and CD79a were positive, as well as Bcl-2 was also positive. CD3, CD30, and CD10 were negative. The standard R-CHOP protocol (cyclophosphamide, doxorubicin, prednisone, rituximab, and vincristine) was initiated for a week after cardiac MR, and the patient underwent follow-up chest CT after six months. The infiltrative

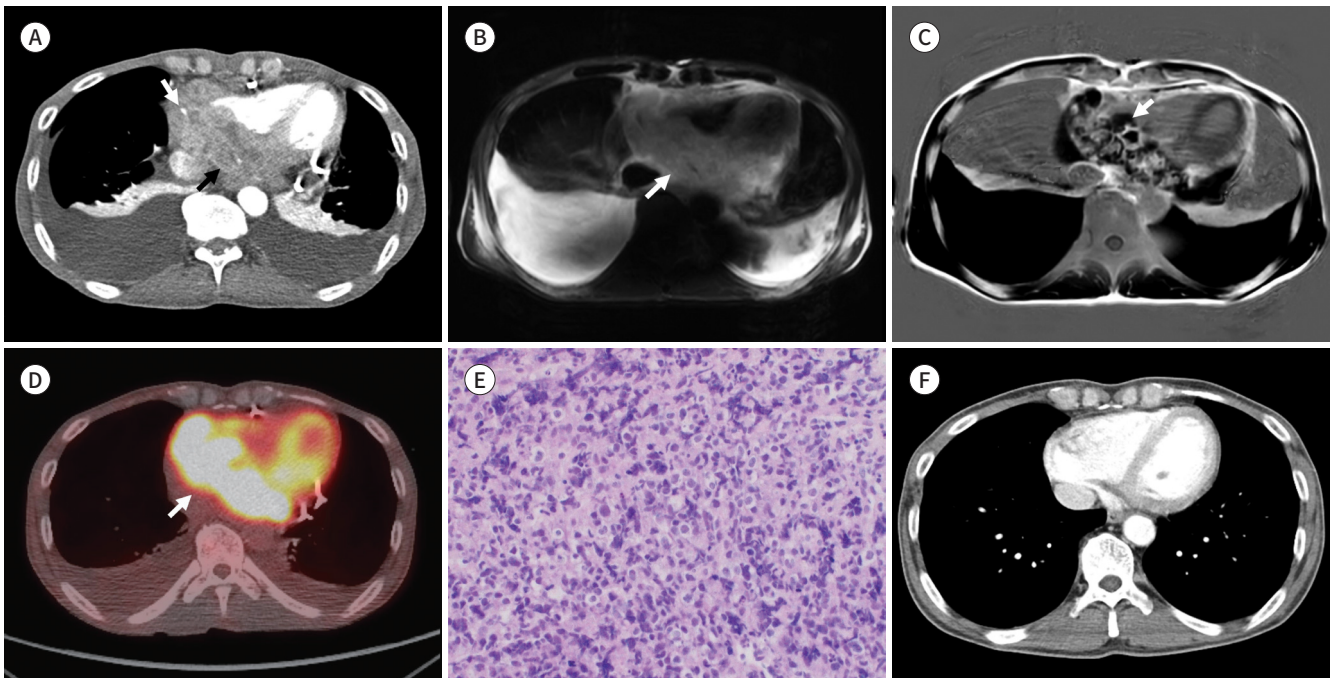
nodular mass at the right lateral and inferior atrioventricular groove, interatrial septum, and basal interventricular septum showed a marked decrease in size and was barely visible compared to the previous imaging study (Fig. 1F).

## CASE 2. CARDIAC METASTASIS

A 76-year-old male presented with dyspnea and weight loss over the past two months before hospitalization. The laboratory findings were unremarkable except for elevated NT-proBNP levels (2491 pg/mL; normal 232–314 pg/mL). TTE revealed a huge mass-like lesion with extensive involvement of both the inferior wall of both ventricles, the interventricular septum, and the right atrium. On cardiac CT, a huge heterogeneous enhancing mass was observed at the basal septum and inferior wall of the left ventricle, with infiltration into the basal inferior wall of the right ventricle (RV) and pericardial space (Fig. 2A-C). The mass encased the RCA without significant stenosis. Two other multifocal distinct nodules were located at the RV free wall. The main mass and two nodules had heterogeneous peripheral enhancement with central low-attenuated portions. A small amount of pericardial effusion was

**Fig. 1.** A 56-year-old male with cardiac lymphoma at the right atrioventricular groove.

- A.** The initial contrast-enhanced chest CT axial image shows a diffuse infiltrative heterogeneous nodular soft tissue mass (black arrow) at the right atrioventricular groove, encasing the right coronary artery (white arrow) and left circumferential artery. There is a large amount of pleural effusion on both sides of the hemithorax.
- B.** Short tau inversion recovery T2-weighted axial image shows infiltrative heterogeneous iso- to subtle high-signal intensity of the mass (arrow) at the right atrioventricular groove and intruding into the right ventricular chamber.
- C.** The contrast-enhanced T1 phase-sensitive inversion recovery axial image shows a prominent heterogeneous, infiltrative, multiple aggregated nodular mass with late gadolinium enhancement and inner low-signal foci (arrow).
- D.** Axial  $^{18}\text{F}$ -fluorodeoxyglucose PET/CT shows diffuse high uptake of the cardiac mass (arrow) without high-uptake lesions in the other body.
- E.** Diffuse infiltration with large B cells is shown in the myocardium (hematoxylin-eosin stain,  $\times 200$ ).
- F.** Follow-up chest CT image after six months shows barely a visible infiltrative nodular mass at the atrioventricular groove, interatrial septum, and basal interventricular septum.



**Fig. 2.** A 76-year-old male with cardiac metastasis from squamous carcinoma of unknown primary origin.

**A.** A heterogeneous enhancing mass (arrow) arising at the basal septum and a 2.0-cm-sized nodule (empty arrow) at the right ventricular free wall are shown on a four-chamber cardiac CT image.

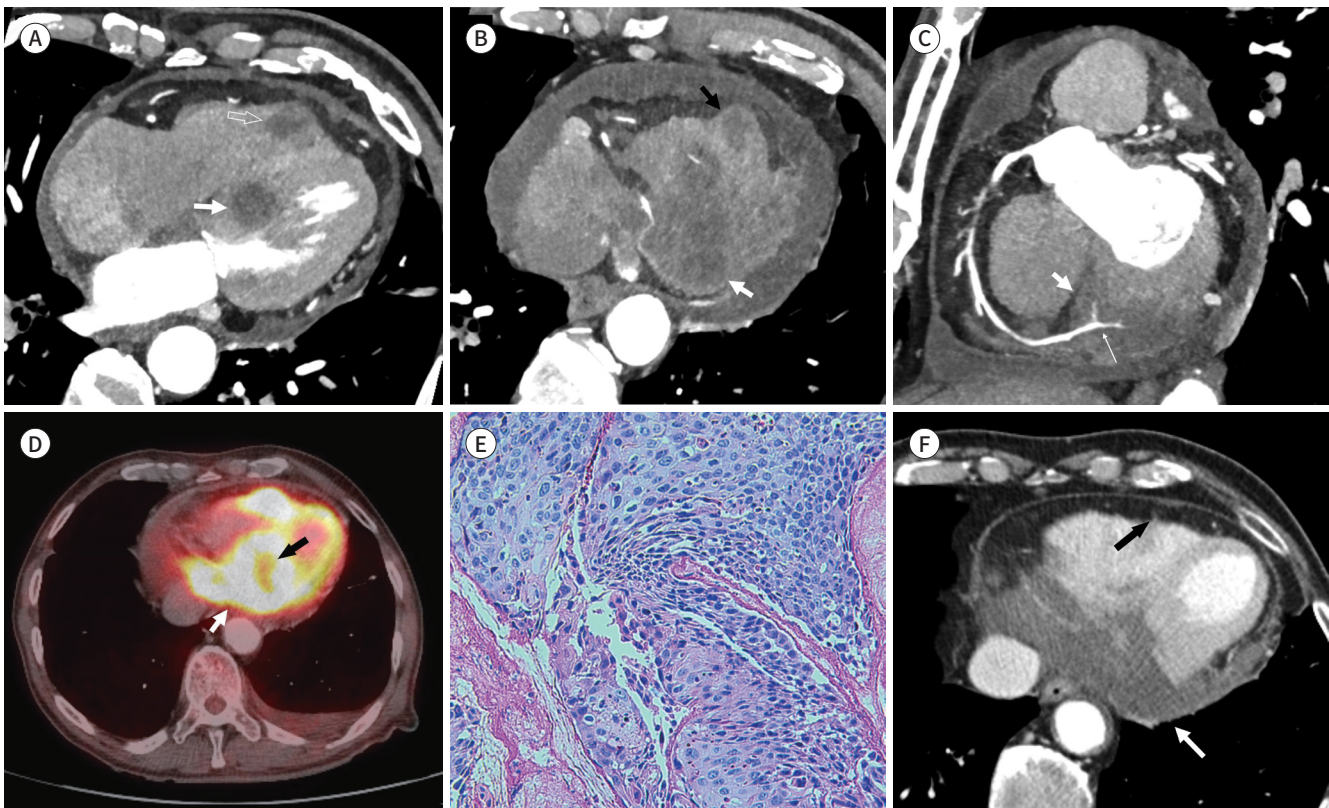
**B.** Large, heterogeneous enhancing main mass (white arrow) infiltrates along the basal inferior wall of the left and right ventricles on four-chamber cardiac CT image. In addition, an approximately 1.6-cm-sized metastatic nodule (black arrow) is seen at the right ventricular free wall.

**C.** Short axis view of the cardiac CT image shows a mass (arrow) at the basal septum and inferior wall of the left ventricle. The mass encases the right distal coronary artery (thin arrow).

**D.** Axial  $^{18}\text{F}$ -fluorodeoxyglucose PET/CT image shows a diffuse high uptake of the cardiac mass (white arrow) with an inner low-uptake portion (black arrow).

**E.** Microscopy demonstrates atypical squamous cancer cells infiltrating the myocardium (hematoxylin-eosin stain,  $\times 200$ ).

**F.** Follow-up chest CT image after one year shows cystic changes of the previous heterogeneous enhancing mass (white arrow) and markedly decreased size of the nodule at the right ventricular free wall (black arrow).



also observed. PET/CT demonstrated high uptake in all the mentioned lesions with low-fluorodeoxyglucose uptake inner portions (Fig. 2D). However, there was no definite evidence of visible primary cancer in the abdominal or thoracic area. An intracardiac echocardiography-guided right atrium mass biopsy was performed. Finally, based on the pathological report, the mass was confirmed as metastatic squamous cell carcinoma (Fig. 2E). From the clinical and imaging findings and the pathologic results, the patient was diagnosed with metastatic squamous carcinoma of unknown origin. Palliative chemotherapy was initiated using gemcitabine and cisplatin. The follow-up chest CT taken after a year revealed cystic changes of the heterogeneous mass and markedly decreased size of the nodules at the RV free wall (Fig. 2F). However, there was still no definite evidence of primary lung malignancy on follow-up chest CT and clinically close follow-up monitoring of the whole body for delayed primary



squamous malignancy will be needed.

## DISCUSSION

We report two cases of cardiac masses with similar locations and image features, which proved difficult to differentiate between lymphoma and metastasis. Both cases showed infiltrative masses involving both sides of the heart, encasement of the RCA without luminal narrowing and a small amount of pericardial effusion. However, no definite primary or additional site of malignancy made the differential diagnosis difficult.

Cardiac tumors present most commonly as cardiac metastases, and primary cardiac lymphoma is a far rarer disease than cardiac metastasis. In general, primary cardiac lymphoma involvement can appear as an infiltrating epicardial or myocardial iso- to hypoattenuating homogeneous enhancing mass on CT. The lesion tends to extend along the epicardial surface, encasing the adjacent coronary arteries, and aortic root (5). The most commonly involved site is the right side of the heart, particularly the right atrium. In the MR images, the mass shows relatively homogeneous hypo-intense signals on T1-weighted image (T1WI) and hyper-intense signals on T2-weighted image (T2WI) compared to the findings in the myocardium. Unlike other malignant tumors, lymphoma generally has minimal contrast agent uptake either homogeneous or heterogeneous in late gadolinium enhancement images (8). The location of cardiac metastasis can differ depending upon the type of primary cancer, but the most common site of involvement is the pericardium (40%) (9). The imaging findings of cardiac metastases are non-specific but mostly infiltrative, heterogeneous, and multiple masses involving the right side of the heart and atria are observed. Commonly, hyper-intense signals in T2WI and hypo-intense signals in T1WI with late gadolinium enhancement in cardiac MR have been reported (10).

Our two cases of cardiac lymphoma and cardiac metastases showed similar clinical manifestations including dyspnea and weight loss. Both cases presented as similar heterogeneous enhancing infiltrative lesions involving the right side of the heart and marked uptake in PET/CT. Also, both the masses encased the RCA without significant luminal narrowing. Similar imaging findings created difficulty in differentiating between metastases and cardiac lymphoma. Furthermore, the absence of primary malignancy as an extrathoracic finding in the second case accounted for the inconclusive diagnosis. Generally, lymphoma shows homogeneous features and metastasis usually shows heterogeneous characteristics in the radiologic findings. In a retrospective review of our cases, cardiac metastasis appeared as a large mass with multifocal intracardiac metastatic nodules and an inner heterogeneous low-attenuated portion compared to the findings of primary cardiac lymphoma. We propose that these imaging findings may help diagnose and differentiate cardiac metastases from primary cardiac lymphoma for radiologists. However, it was difficult to differentiate on the imaging findings of the infiltrative cardiac masses. Diagnostic intervention and pathologic confirmation are critical for diagnosing cardiac tumors.

### Author Contributions

Conceptualization, L.H.J., K.S.S.; data curation, L.H.J., K.S.S., A.K.T., K.K.H.; formal analysis, L.H.J.,

K.S.S.; supervision, K.S.S., K.J.H., A.K.T., K.K.H.; validation, L.H.J., K.S.S.; writing—original draft, L.H.J.; and writing—review & editing, all authors.

### Conflicts of Interest

The authors have no potential conflicts of interest to disclose.

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## REFERENCES

1. McAllister Jr HA. Tumors of the cardiovascular system. Atlas of tumor pathology. *Armed Forces Institute of Pathology Series* 1978;2:106-107
2. Süttsch G, Jenni R, von Segesser L, Schneider J. Heart tumors: incidence, distribution, diagnosis. Exemplified by 20,305 echocardiographies. *Schweiz Med Wochenschr* 1991;121:621-629
3. Zhong L, Yang S, Lei K, Jia Y. Primary cardiac lymphoma: a case report and review of the literature. *Chin Ger J Clin Oncol* 2013;12:43-45
4. Chen KW, Chang JH, Yeh SP, Lu CR. Primary cardiac B-cell lymphoma with atrioventricular block and paroxysmal ventricular tachycardia. *J Cardiothorac Surg* 2012;7:70
5. Jeudy J, Kirsch J, Tavora F, Burke AP, Franks TJ, Mohammed TL, et al. From the radiologic pathology archives: cardiac lymphoma: radiologic-pathologic correlation. *Radiographics* 2012;32:1369-1380
6. Kim EY, Choe YH, Sung K, Park SW, Kim JH, Ko YH. Multidetector CT and MR imaging of cardiac tumors. *Korean J Radiol* 2009;10:164-175
7. Burazor I, Aviel-Ronen S, Imazio M, Goitein O, Perelman M, Shelestovich N, et al. Metastatic cardiac tumors: from clinical presentation through diagnosis to treatment. *BMC Cancer* 2018;18:202
8. O'Donnell DH, Abbara S, Chaithiraphan V, Yared K, Killeen RP, Cury RC, et al. Cardiac tumors: optimal cardiac MR sequences and spectrum of imaging appearances. *AJR Am J Roentgenol* 2009;193:377-387
9. Klatt EC, Heitz DR. Cardiac metastases. *Cancer* 1990;65:1456-1459
10. Lichtenberger JP 3rd, Reynolds DA, Keung J, Keung E, Carter BW. Metastasis to the heart: a radiologic approach to diagnosis with pathologic correlation. *AJR Am J Roentgenol* 2016;207:764-772

## 영상 소견으로 감별이 어려운 원발성 심장 림프종과 심장 전이암: 2예 보고

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심장 종양은 매우 드물고 다양한 영상의학적 소견을 보이거나 영상 소견만으로는 감별이 쉽지 않다. 저자들은 영상 소견으로 감별이 어려웠던 두 증례인, 드문 원발성 심장 림프종양과 전이성 심장암 증례에 대하여 보고하고자 한다.

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