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[Case report]

Different prognostic outcomes in two cases of FDG-PET/CT-Positive and -negative cardiac angiosarcoma

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Abstract

Cardiac angiosarcoma is a rare malignant tumor with a poor prognosis, characterized by the high uptake of ^{18}F-fluorodeoxyglucose (FDG). This case report presents two cases of cardiac angiosarcoma with a marked difference in FDG uptake and prognosis.

Case Summary :

Case 1 : A 40-year-old male presented with syncope. Ultrasound echocardiography demonstrated a cardiac tumor with a high uptake of ^{18}F-FDG (maximum standardized uptake value=9.2). The patient underwent heart catheterization and tumor biopsy. The pathological result was high-grade angiosarcoma, and the MIB-1(Ki-67) proliferation index was approximately 20%. Systemic chemotherapy was administered ; however, the patient died 2 years and 5 months after disease onset.

Case 2 : A 65-year-old female had a right atrial tumor incidentally diagnosed during routine ultrasound echocardiography. The tumor exhibited a low uptake of ^{18}F-FDG (maximum standardized uptake value=1.8). Open heart surgery was performed, and the tumor was completely resected. Histological analysis revealed low-grade angiosarcoma, and the MIB-1(Ki-67) proliferation index was less than 5%. The patient was followed-up and had not relapsed 2 years after surgery.

Conclusion : ^{18}F-FDG uptake may reflect pathological tumor grade and prognosis in cardiac angiosarcoma.

Key words : FDG-PET, Cardiac angiosarcoma, MIB-1 index

Introduction

Primary cardiac tumors are rare, and postmortem studies have reported that the prevalence of these tumors is less than 0.3%[1,2)]. In addition, 25% of these tumors are malignant. Angiosarcoma is the most common primary cardiac malignancy and has a poor prognosis[3,4)]. Angiosarcomas occur near the interatrial septum and in the pericardium[4)], and the diagnosis is often delayed because of asymptomatic progression[5)]. Ultrasound echocardiography is commonly used to detect these tumors. Moreover, positron emission tomography/computed tomography (PET/CT) is useful for the detailed characterization of tumors. Angiosarcomas have a high uptake of ^{18}F-fluorodeoxyglucose (FDG)[6)]. This case report presents two cases of cardiac angiosarcoma with appreciable differences in FDG uptake and prognosis. The results suggest that cardiac angiosarcomas with low FDG uptake have a good prognosis.

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Case report

Case 1

A 40-year-old male with general malaise and loss of consciousness visited our hospital's emergency and critical care center. Ultrasound echocardiography was performed because of suspected syncope due to cardiopathy. The results showed a massive pericardial effusion, and carcinomatous pericarditis was suspected. CT was performed and identified multiple lung metastases but not primary tumors (Figure 1A). ^{18}F-FDG PET/CT was performed using a hybrid scanner (Biograph mCT PET/CT, Siemens Healthcare, Erlangen, Germany). After a 6 h fast, 200 MBq ^{18}F-FDG was injected intravenously 60 min before image acquisition. Blood glucose at the time of FDG administration was 108 mg/dl. A whole-body scan was performed using a low-dose mode for unenhanced CT (120 kV, 210 mAs). Increased glucose metabolism was observed in the right atrium with a maximum standardized uptake value (SUVmax) of 9.2 (Figure 1B, C), suggesting a heart tumor. Retrospective ECG-gated cardiac CT was performed using a 64-slice multidetector scanner and a contrast administration protocol optimized for visualizing the right atrium (Figure 1D). The results confirmed the diagnosis of a right atrial tumor.

Ultrasound-guided pericardial drainage and cytology were performed for definitive diagnosis. No malignancy was detected. The patient underwent right heart catheterization and endomyocardial biopsy of the atrial tumor. Histopathology showed that

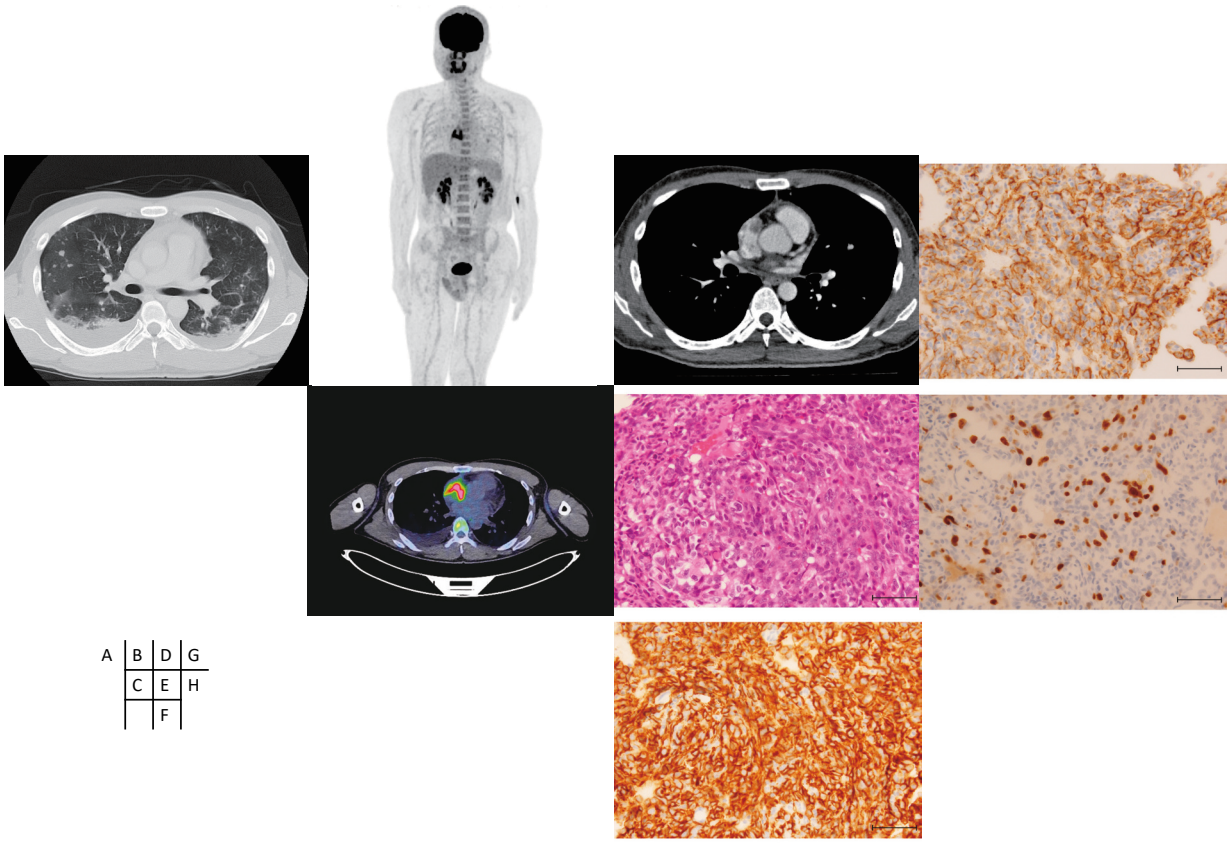

Fig. 1. A 40-year-old male with high-grade angiosarcoma (case 1).
A. Computed tomography (CT) (lung window settings) shows multiple lung metastases.
B and C. Maximum intensity projection positron emission tomography (PET) (B) and axial fused PET/CT (C) images show moderate to intense fluorodeoxyglucose uptake in the right atrium (maximum standardized uptake value=9.2).
D. Retrospective electrocardiogram-gated cardiac CT shows a hypovascular tumor in the right atrium.
E. Photomicrographs (H and E, ×400) of a biopsy specimen show high-grade malignant vascular proliferation with cytologic atypia and increased mitotic activity.
F, G, and H. Immunohistochemical staining for CD31, CD34, and Ki-67 (×400, scale bars=50 μm). Tumor cells showed positive immunoreactivity for CD31 (diffuse), CD34 (diffuse), and Ki-67. The MIB-1(Ki-67) proliferation index was approximately 20%.

the tumor was a malignant vascular neoplasm with high-grade cytological atypia (Figure 1E). Tumor cells were positive for endothelial markers CD31 and CD34 (Figure 1F, G).[4,7] Moreover, the MIB-1(Ki-67) proliferation index, a cell proliferation marker,[8] was approximately 20% (Figure 1H), indicating an aggressive malignancy. Based on these findings, the atrial tumor was classified as high-grade angiosarcoma.

The patient underwent systemic chemotherapy with the weekly administration of paclitaxel ; however, treatment was discontinued after 10 months because of disease progression. Eribulin mesylate was administered ; nonetheless, treatment was interrupted after 3 months because of disease progression. Pazopanib therapy was initiated but was discontinued after 6 months because of metastasis to the lung, lumbar spine, and brain. The patient died 2 years and 5 months after the diagnosis.

Case 2

A 65-year-old woman visited our hospital for a routine evaluation of cardiac function before initiating hemodialysis. She had goiter in her 20s, breast and ovarian cancer in her 50s, hypertension, and chronic renal failure. She had undergone total hysterectomy with resection of both uterine adnexa and pelvic lymph node dissection. Ultrasound echocardiography for routine evaluation of cardiac function revealed a tumor in the right atrium. Retrospective ECG-gated cardiac CT and whole-body CT scans revealed a hypervascular tumor in the right atrium without metastasis (Figure 2A).

For a more detailed evaluation, ^{18}F-FDG PET/CT was conducted as described above. After a 6 h fast, the patient was intravenously injected with 153 MBq ^{18}F-FDG 60 min before image acquisition. The blood glucose level at the time of FDG

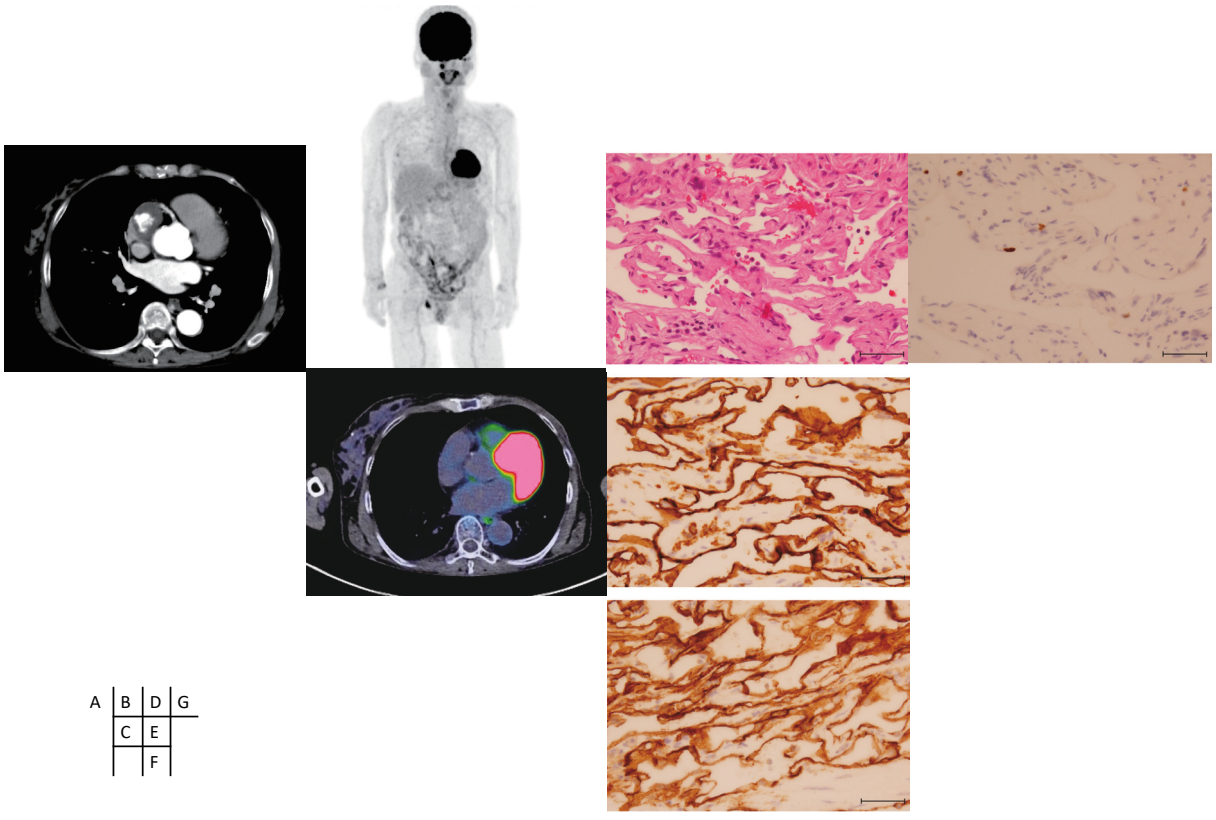

Fig. 2. A 65-year-old female with low-grade angiosarcoma (case 2).
A. Retrospective electrocardiogram-gated cardiac computed tomography (CT) shows a hypervascular tumor in the right atrium.
B and C. Maximum intensity projection positron emission tomography (PET) (B) and axial fused PET/CT (C) images show the low uptake of fluorodeoxyglucose in the right atrium (maximum standardized uptake value=1.8).
D. Photomicrographs (H and E, ×400) of a biopsy specimen show malignant vascular proliferation with arranged in papillae and form vascular structures.
E, F, and G. Immunohistochemical staining for CD31, CD34, and Ki-67 (×400, scale bars=50 μm). Tumor cells showed positive immunoreactivity for CD31 (diffuse), CD34 (diffuse), and Ki-67. In contrast, the MIB-1(Ki-67) proliferation index was less than 5%.

administration was 81 mg/dl. ^{18}F-FDG PET/CT scans showed low FDG uptake by the tumor (SUVmax=1.8) (Figure 2B, C).

Open heart surgery was performed because there were no metastases, total tumor resection was feasible, and the right atrial tumor was completely removed. Histopathological findings revealed a malignant vascular neoplasm with mild cytological atypia (Figure 2D). Tumor cells were positive for CD31 and CD34 (Figure 2E, F), and the MIB-1(Ki-67) proliferation index was less than 5% (Figure 2G). Thus, the atrial tumor was classified as low-grade angiosarcoma. The patient was followed-up with ultrasound echocardiography and had no metastases 2 years after the surgery.

Discussion

We evaluated two cases of cardiac angiosarcoma. In the first case, the tumor had a high uptake of ^{18}F-FDG and a poor prognosis and was classified as cardiac angiosarcoma. In the second case, the tumor had a low tracer uptake and a good prognosis. A search on the PubMed database using the MESH terms "cardiac angiosarcoma," "low uptake," and "PET" retrieved no citations. To our knowledge, this case report is the first to describe a case of cardiac angiosarcoma with a low ^{18}F-FDG tracer uptake and a favorable outcome.

FDG is a marker of glycolysis, and ^{18}F-FDG PET/CT is an imaging tool useful for detecting and grading tumors.[9] FDG uptake is associated with malignancy in cardiac tumors. For instance, Kambiz *et al.*[10] reviewed ^{18}F-FDG PET/CT scans of 24 patients with cardiac tumors, including six patients with cardiac angiosarcoma, and found that SUVmax was significantly higher in malignant tumors. Using a SUVmax of 3.5 as the cutoff value, the sensitivity and specificity for detecting malignant tumors were 100% and 86%, respectively. Using the above criteria in our patients, case 1 would be classified as malignant, and case 2 would be misclassified as benign. However, case 2 showed a favorable course, which is rare in cardiac angiosarcoma. Low FDG uptake may reflect low malignancy.

Angiosarcoma grade may be associated with FDG uptake. For instance, Kato *et al.*[11] examined the relationship of histologic tumor grade with quantitative parameters in ^{18}F-FDG PET/CT and overall survival in 16 patients histologically diagnosed with angiosarcoma and found that SUVmax was significantly higher in high-grade tumors than in low-grade tumors. Thus, this result may also be true for cardiac angiosarcoma.

FDG uptake and the MIB-1(Ki-67) proliferation index were associated with clinical outcomes in non-small-cell lung cancer[12] and pulmonary neuroendocrine tumors.[13] SUVmax was significantly higher in tumors with a higher MIB-1(Ki-67) proliferation index. Therefore, FDG uptake may reflect pathological tumor grade in patients with cardiac angiosarcoma.

In conclusion, we present two cases of cardiac angiosarcoma with appreciable differences in FDG uptake and prognosis. One case was typical cardiac angiosarcoma with poor prognosis and high MIB-1(Ki-67) proliferation index, and the other was an atypical case with low FDG uptake, good prognosis, and low MIB-1(Ki-67) proliferation index. These results suggest that FDG uptake reflects pathological tumor grade and prognosis in patients with cardiac angiosarcoma. Nonetheless, further research is required to corroborate these findings.

Conflict of interest disclosure

The authors have no conflicts of interest to declare.

Contributors

All authors were involved in patient care and contributed to the conception, drafting, and review of the manuscript. All authors have read and approved the final version of the manuscript and take full responsibility for the work.

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Data availability

The data supporting the results of this case report are the property of the participating hospital.

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