Editorial

Editorial: Cardiac tumors: Histopathological aspects and assessments with cardiac noninvasive imaging

Cardiac tumors are rare. Cardiac tumors comprise primary and secondary metastatic tumors. The frequency of cardiac tumors is low with an estimated cumulative prevalence of approximately 0.002% by autopsy or 0.15% by echocardiographic evaluations [1,2]. The majority of primary cardiac tumors are benign (approximately 75% of primary tumors), and of those, myxoma is the commonest (more than 50% of primary benign cardiac tumors), followed by fibroelastoma, fibromas, rhabdomyoma, hemangioma, and lipomas [3]. Primary malignant cardiac tumors are also rare and can be broadly divided into sarcomas, malignant lymphomas, and pericardial mesothelioma [4]. Of those, cardiac sarcomas are predominant. Angiosarcoma is the commonest primary malignant tumor in adulthood, while rhabdomyosarcoma is more frequently observed in children [4,5]. Metastatic cardiac tumors are more frequent than primary tumors with a ratio of approximately 40 times [6]. The incidence reportedly ranges from 2.3% to 18.3% [7]. In autopsy reports, patients with known malignant neoplasmas have cardiac metastatic involvement in 10–12% of cases [8]. The commonest metastatic cardiac tumor is bronchogenic carcinoma, followed by malignant lymphomas, malignant melanoma, leukemia, and carcinomas from the breast, esophagus, and kidney. The commonest site of involvement is the pericardium with or without invasion of the myocardium, and progressive pericardial effusion is observed.

In the primary benign tumors, myxoma is thought to arise from pluripotent mesenchymal cells associated with embryonal residues in the subendocardium [9,10]. The configuration is polypoid and pedunculated with a lobulated surface. Some of them show malignant transformation. The majority (approximately 75%) of myxomas develop in the left atrium. Others arise from the right atrium. Most arise from a narrow attachment point at the fossa ovalis of the interatrial septum. Left atrial myxomas hemodynamically mimic mitral stenosis, leading to dyspnea or orthopnea. Right atrial myxoma obstructs the tricuspid valve, indicating

symptoms caused by right heart failure [11,12]. Embolism occurs in 30–40% of patients and is frequently to the cerebral circulation [13]. Papillary fibroelastoma is the second commonest benign cardiac tumor [11]. This tumor is histologically composed of a fine meshwork collagen and elastic fiber covered by endothelium. The atrial surfaces of the mitral valve and aortic valve are the commonest sites. Fibroma is well-circumscribed aggregates of collagen and fibroblast and arises in the intramyocardium [11]. This tumor is frequently observed in infants and children. Rhabdomyoma is also observed in children (approximately 90% of primary cardiac tumors in children) [11]. Lipoma is a neoplasm composed of adipose tissue [11]. Hemangioma is a rare tumor which is discovered accidentally in the myocardium by autopsy, and does not cause clinical problems [11].

In primary malignant cardiac tumors, sarcomas are predominant [2,14]. In particular, angiosarcoma is the commonest tumor. This tumor is composed of irregularly shaped vascular channels related to anaplastic epithelial cells with sizable areas of necrosis and hemorrhage. This tumor is frequently observed in the fourth decade male, and raises from the right atrium. This tumor typically invades the right atrial chamber with extensive infiltration into adjacent structures which correspond to the pericardium, vena cavae, tricuspid valve, right coronary artery, and right ventricle. Metastasis is often found in the lungs, liver, bones, and brain, resulting in poor prognosis. Sarcomas with myofibroblastic differentiation are a diverse group of primary malignant cardiac tumors which contain heterogeneous elements [14]. These sarcomas are classified into three malignant tumors as follows: undifferentiated sarcomas, liposarcoma, and leiomyosarcoma [14]. These tumors are often observed in the left atrial posterior wall and typically exhibit slow infiltration into adjacent structures. Rhabdomyosarcoma comprising embryonal cells is one of the common primary pediatric cardiac tumors [14]. Primary cardiac lymphoma is much more infrequent than secondary involvement. This is exceedingly rare, representing approximately 1% of primary cardiac tumors [15]. The majority occurs in immunocompromised patients, and is of B-cell origin. The right atrium is the commonest site of origin with frequent involvement of more than 1 chamber and pericardial invasion.

In metastatic cardiac tumors, the incidence of metastatic secondary cardiac tumors is approximately 40 times more frequent than that of primary ones, but most of them remain clinically silent [7]. They generally appear late after the onset of the primary disease and isolated cardiac involvement is rarely observed without dissemination to the other organs. Since the pericardium is more often involved than the myocardium,

progressive breathlessness and signs of cardiac tamponade are commonly observed symptoms owing to accumulation of malignant pericardial effusion.

Clinical manifestations of cardiac tumors are diverse and nonspecific. There are no typical symptoms which depend on tumor size and locations. Most tumors remain clinically silent, while some of them present with symptoms, for example dyspnea, orthopnea, chest pain, or edema on lower legs, relating with intracardiac obstruction, arrhythmias, or systematic obstruction. The primary benign cardiac tumors are usually resected with minimal morbidity and most patients have a good clinical course. However, some benign tumors need surgical operations dependent on the risk of complications, tumor size, or locations. Some malignant tumors may be treated with surgical resection if they are discovered in the early phase, but generally their prognosis is not so good even if chemotherapies are administered [11,16,17]. Actually, integrated chemotherapies are partially effective for primary and secondary malignant cardiac tumors.

In general, trans-thoracic echocardiography (TTE) is a first-line, convenient, and useful modality to detect cardiac tumors. However, TTE cannot fully evaluate an invading cardiac mass due to a limitation of field-of-view [18]. Trans-esophageal echocardiography (TEE) provides more detailed information about small masses and masses particularly those infiltrated into the atrium or cardiac valves [19]. However, TEE is a more uncomfortable test for patients than TTE. In addition, both TTE and TEE cannot provide precise tissue characterizations and confidential differentiations between thrombus and tumors [20]. Electrocardiographically gated multi-detector computed tomography (MDCT) scanners have recently merged acquisition speed and high special resolution with volumetric scanning to provide excellent anatomic details. MDCT provides complemental assessments of cardiac muscle with coronary artery configuration [21,22]. However, MDCT cannot differentiate the detailed soft-tissue characterization and offers a relatively high radiation exposure. Cardiac magnetic resonance (CMR) imaging overcomes these flaws of the above-mentioned modalities, allowing integrated and comprehensive assessments of the cardiac muscle, pericardium, and adjacent organs, if patients do not have implanted ferromagnetic devices or are not claustrophobic [22]. This modality has several advantages including an unrestricted field-of-view and superior soft-tissue contrast. This modality can be used to localize and characterize cardiac masses with the use of the following techniques: CMR pulse sequences, black-blood techniques, bright-blood techniques, and first-pass perfusion and delayed enhancement imaging using gadolinium contrast media.

In a case report by Pedrotti et al. [23], they present a rare and unique case indicating metastatic melanoma, with a large amount of effusion, in both the pericardium and myocardium. The tumor origin was confirmed as metastasis of melanoma by echocardiography, cardiac CT, and CMR imaging, but the pathological malignancy by pericardiocentesis was not evident. In particular, CMR imaging provides great clues for the final diagnosis for identifying the origin (primary cardiac tumor or secondary metastatic melanoma). Since melanoma signal characteristics are dependent on the content of melanin, natural paramagnetic substance causes T1-shortening. Then, melanoma indicates a high signal on T1-images and low signal on T2-images. These characteristics may help diagnose origins of metastatic tumors. The final diagnosis was defined as metastasis of subcutaneous melanoma operated 10 years previously by biopsy specimens. They conclude that the comprehensive assessments using cardiac noninvasive imaging modalities are crucial to enable the diagnostic work-up in such a complex case.

The diagnosis of cardiac tumors is difficult. However, as mentioned by Pedrotti et al., multi-disciplinary imaging approach plays a key role in the diagnostic work-up and management of complex cases with cardiac tumors.

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