Scientific Research Publishing

Journal of Biosciences and Medicines, 2024, 12, 141-150
https://www.scirp.org/journal/jbm
ISSN Online: 2327-509X
ISSN Print: 2327-5081

Diagnostic Dilemma of Intracardiac Mass: Tumor versus Thrombus-Case Series and Systematic Review

Indira Acharya[1], Ashik Pokharel[1], Raktim Ghosh[2], Christopher J. Haas[1,3]

[1]Department of Internal Medicine, Internal Medicine Residency Program, Medstar Health, Baltimore, MD, USA
[2]Department of Cardiology, MedStar Union Memorial Hospital, MedStar Health, Baltimore, MD, USA
[3]School of Medicine, Georgetown University, Washington, D.C., USA
Email: acharyaindira99@gmail.com

How to cite this paper: Acharya, I., Pokharel, A., Ghosh, R. and Haas, C.J. (2024) Diagnostic Dilemma of Intracardiac Mass: Tumor versus Thrombus-Case Series and Systematic Review. *Journal of Biosciences and Medicines*, **12**, 141-150.
https://doi.org/10.4236/jbm.2024.127013

Received: May 25, 2024
Accepted: July 15, 2024
Published: July 18, 2024

Abstract

Background: The differential diagnosis for intracavitary cardiac masses is limited, typically including vegetations, tumors, or thrombi. Cardiac thrombi can often mimic cardiac tumors on imaging, creating a diagnostic challenge. Primary cardiac tumors are rare and usually benign, whereas most cardiac tumors result from metastases, commonly originating from malignancies in the breast, lung, or melanoma. Aim: This report highlights the importance of distinguishing various cardiac masses based on clinical presentations, clinical courses, and radiological features. Case Presentation: We describe two cases of cardiac masses with unique and diverse clinical features. Each case posed significant diagnostic challenges due to their distinct presentations and clinical progressions. Conclusion: These cases underscore the importance of considering both benign and metastatic origins in the differential diagnosis of intracavitary cardiac masses. Accurate differentiation between thrombi and tumors is crucial for appropriate management and treatment.

Keywords

Echocardiography, Cardiac Masses, Arrhythmias, Cardiac Magnetic Resonance Imaging, Cardiac Thrombi

1. Introduction

In comparison to left cardiac thrombus, right cardiac thrombus is relatively uncommon [1]. However, the right atrium is frequently affected by metastatic involvement [2]. Individuals with cardiomyopathies have the highest incidence of

cardiac thrombi [3], and there are also rare but significant risk factors for thromboembolic events like factor V Leiden mutation, inflammatory bowel disease (IBD), and certain medications like Infliximab [4]-[6].

Although the appearance of thrombi in various imaging modalities may resemble tumors, specific factors like a history of atrial fibrillation, smoking, myocardial infarction, and other existing hypercoagulable risk factors for thromboembolism, along with a reduction in size during follow-up, favor the diagnosis of cardiac thrombus over cardiac neoplasm [2]. Echocardiography has been an invaluable tool in both diagnosing and facilitating long term follow up in the patients with cardiac masses. However, in certain cases where it struggles to accurately differentiate between a cardiac tumor and a thrombus, cardiac MRI emerges as a reliable alternative for detecting and characterizing cardiac masses.

The objective of this paper is to discuss and illustrate challenging cases involving intracardiac masses, focusing on the diagnostic complexities between cardiac thrombi and tumors, along with their respective management considerations and implications.

2. Case 1

A 54-year-old woman presented to emergency department with a progressive shortness of breath that had been worsening over the course of one week. It was not related to exertion and persisted even at rest, without any associated symptoms of cough, fever, orthopnea, paroxysmal nocturnal dyspnea, wheezing, or leg swelling. She reported no chest pain; however, she had been experiencing a continuous, non-radiating, stabbing pain in her right shoulder for the past year, which was attributed to osteoarthritis. The shoulder pain was not alleviated by scheduled oral analgesics and physical therapy. Furthermore, she had unintentionally lost approximately 22 pounds, over the course of two months without any associated nausea, vomiting or anorexia.

Medical history was notable for 25-pack-year smoking history, intravenous drug use, and coronary artery disease with percutaneous coronary intervention and stenting of right coronary artery 5 years ago. Her home medications comprised of daily doses of aspirin 81 mg, atorvastatin 80 mg, methadone 100 mg daily, Ibuprofen 600 mg three times daily, acetaminophen 1 g three times daily. Her family history was significant for the death of her sister at the age of 35 due to lung cancer and death of her father at the age of 53 due to myocardial infarction.

On presentation, the patient was noted to have sinus tachycardia (110 beats per minute) and tachypnea (24 breaths per minute) but was normotensive, with a preserved oxygen saturation on room air. Physical examination was unremarkable except for the noted sinus tachycardia and non-pitting edema of the left lower extremity with associated tenderness of left calf muscle. Laboratory diagnostics demonstrated anemia with hemoglobin of 6.7 gm/dl (reference range: 11.0 - 14.5 gm/dl; MCV 86 fL, reference range: 81 - 100 fL), leukocytosis

of 40.2 K/uL (reference range: 4 - 10.8 K/uL) with bandemia (neutrophil: 90%, reference range: 43% - 75%; lymphocyte: 3.2%, reference range: 15% - 45%), an elevated LDH of 461 units/L (reference range: 84 - 246 units/L), elevated NT proBNP of 1470 pg/ml (reference range: 0 - 99 pg/ml), and a D-dimer >20 mcg/ml FEU (reference range: ≤ 0.54 mcg/ml FEU). EKG showed sinus tachycardia with frequent PVCs with prolonged QTC of 571 ms. Her chest x-ray showed a suspicious mass in the upper right lobe of lung that prompted a computed tomography (CT) pulmonary angiogram showing pulmonary embolism in right upper lobe branch of the pulmonary artery along with a right pancoast tumor with possible metastasis to left ventricular apex. There was overlying pericardial and epicardial soft tissue, right axillary and juxta-clavicular nodes, and a filling defect in right ventricle. Venous duplex of lower extremities also showed acute deep vein thrombosis of left peroneal vein. She was started on therapeutic enoxaparin for pulmonary embolism and acute left lower extremity deep vein thrombosis.

Her metastatic workup included a positive CA-125, CA 19-9. CT of abdomen revealed a necrotic pelvic mass with internal vascularity and associated subcentimeter sclerotic foci in the L4/L5 vertebral bodies. The transthoracic echocardiogram demonstrated a round, echo-dense, mobile lesion in the right ventricular apex and mid cavity; there was no evidence of right ventricular strain. Cardiac MRI (Figure 1) confirmed the findings, revealing two separate infiltrating masses within the left ventricle and multiple masses within right ventricle, both of which infiltrated into ventricular myocardium and extended to the pericardium causing global hypokinesis. These masses were concerning for metastatic disease as they were T2 bright and enhanced heterogeneously on late gadolinium. Cardiovascular surgery was consulted, however in the setting of her comorbidities and multiple metastasis, she was deemed a poor surgical candidate.

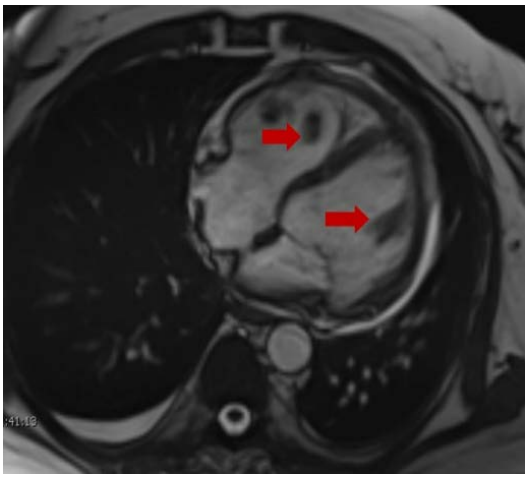

Figure 1. Cardiac MRI demonstrates two separate infiltrating masses within the left ventricle and multiple masses within right ventricle, both of which infiltrated into ventricular myocardium and extended to the pericardium.

Image guided biopsy of right supraclavicular node showed lymphoid tissue with focal arterial cells with associated fibroadipose tissue and thrombus material with no definite malignancy. Repeat biopsy from right chest wall showed poorly differentiated carcinoma with associated necrosis which were positive for CAM 5.2, CK7, and TTF-1 suggesting a primary lung adenocarcinoma. Unfortunately, prior to commencing chemotherapy, the patient's condition continued to decline with worsening shortness of breath along with pelvic, chest and right shoulder pain. She was later transitioned to comfort care and was admitted to a hospice requiring multiple breakthrough analgesics.

3. Case 2

A 24-year-old woman with medical history of ulcerative colitis and iron deficiency anemia presented to emergency department in context of a brief syncopal episode after having one week of worsening lightheadedness and watery diarrhea. She denied smoking or alcohol intake. Her home medications included iron tablets and recently started infliximab. She was on birth control pills for about five years which she discontinued approximately a month ago. Family history was significant for Crohn's disease in father and provoked pulmonary embolism in grandmother in her 20s in the setting of oral contraceptives.

Initial vital signs were notable for tachycardia (120 beats per minute) and hypotension (80/50 mm Hg) with a preserved respiratory rate and oxygen saturation on ambient air. The examination was unremarkable except for the noted sinus tachycardia. The laboratory diagnostics were unremarkable except for hemoglobin of 5.1 gm/dl (reference range: 11.0 - 14.5 gm/dl; MCV 83 fL, reference range: 81 - 100 fL). The cause of syncopal episode was initially attributed to acute anemia and orthostatic hypotension secondary to ongoing diarrhea in setting of ulcerative colitis. The patient was placed in a tapering dose of oral steroid therapy. CT of abdomen/pelvis with contrast showed an incidental soft tissue mass within right ventricle. Transthoracic echo demonstrated a mobile echogenic right ventricular mass which was further confirmed by transesophageal echocardiogram that showed a large mass suspended in right ventricular sub-valvular apparatus with no obvious attachment to right ventricle or tricuspid valve. CT pulmonary angiogram showed acute bilateral segmental pulmonary embolism with redemonstration of 3.3 cm hypodense mass within right ventricle; lower extremity venous duplex was negative for deep vein thrombosis. Given the ambiguity for thrombus versus mass, cardiac MRI was pursued that showed a large multilobulated mass within the right ventricle with tissue characterization most consistent with thrombus (**Figure 2**) for which heparin drip was started.

Hypercoagulable workup demonstrated a double heterozygos for factor V Leiden and prothrombin gene mutation; anticardiolipin antibody and beta-2-glycloprotein were negative. She was advised against the use of hormonal medications and Infliximab was switched to Vedolizumab. At her two months fol-

low up, transesophageal echocardiogram showed a stable size mass attached to poster-septal aspect of right ventricle that had not changed in size. Cardiac MRI was repeated and demonstrated a slightly more elongated mass that bridged the tricuspid valve and the right ventricular trabeculations, similar to the prior study; the extension into the trabeculations was much less compared to previous study. The mass protruded mildly into right atrium during systole and was isointense to myocardium in true FISP images, but there was no evidence of perfusion or enhancement with gadolinium suggesting that it was not vascular structure.

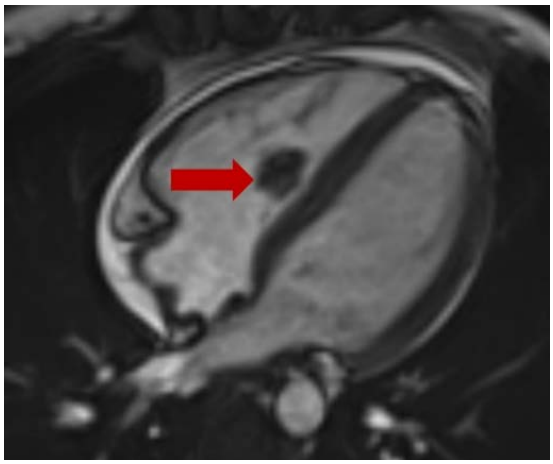

Figure 2. Cardiac MRI demonstrates a large multilobulated mass within the right ventricle with tissue characterization most consistent with thrombus.

PET myocardial imaging demonstrated no hyper metabolic lesion in right ventricular cavity to correspond with mass described in MRI. However, the size of mass did not change significantly despite two months of anticoagulation, suggestive of an organized thrombus superimposed upon a primary benign cardiac tumor. Given the lack of improvement, the patient was recommended for surgical intervention, however, she was reluctant. Repeat MRI one year later demonstrated a decreased size of the mass.

4. Discussion

Cardiac thrombus can be caused by an embolism (type A) or immobile mural thrombus (type B) [7]. It is most commonly found in the left cardiac chamber, occurring in 30% of cases of acute or healed myocardial infarction [7]-[9]. Right cardiac thrombi are much less common,but is potentially fatal [8] [10]. Approximately 2.6% - 18% of those with right cardiac thrombus also have pulmonary embolism [10].

Thrombus development is a complex process involving endothelial damage, hemostasis, and hypercoagulability, known as Virchow's Triad [3] [11]. Individuals at a higher risk for cardiac thrombi include those with cardiomyopathies

(68.5%), acute myocardial infarction (25.6%), Behcet's Disease, hypercoagulable states, systemic lupus erythematosus, Sweet's syndrome, trauma, Takotsubo cardiomyopathy, post-procedure (coronary artery bypass grafting, atrial septal repair), those with ventriculoarterial shunts or permanent pacemakers (5.9%) [3] [12] [13]. It is estimated that 5% of the population carries Factor V Leiden mutation of the F5 gene and is present in 20% of those experiencing their first thrombotic event [10]-[12]. This mutation leads to a decreased activity of activated protein C resulting in 3 to 8-fold increase in the risk of venous thrombosis compared to those without the hereditary risk factor [4] [5]. Furthermore, individuals with cancer and the Factor V Leiden or prothrombin 20210A mutation may have an even higher risk of thrombosis [11]. Thromboembolic events in inflammatory bowel disease is caused by a combination of acquired and inherited factors resulting in an increased propensity for thrombosis in the local intestinal microvasculature as well as in systemic circulation [1] [5] [14]. Risk of thromboembolism with Infliximab therapy has been hypothesized to be linked to an elevation in Beta-2-glycoprotein I (B2GPI)-IgM levels [15]. In our second case, the patient had a medical history of ulcerative colitis and had recently initiated Infliximab treatment. Additionally, she was diagnosed with Factor V Leyden and a prothrombin gene mutation, which could have potentially contributed to an elevated risk of cardiac thrombus formation.

Identification of cardiac thrombus is challenging, because most of the times patients are asymptomatic and the condition is only found incidentally [14]. Yet, it is imperative to make a diagnosis, since untreated cardiac thrombus can lead to systemic or pulmonary embolism [8]. To confirm the diagnosis of cardiac thrombus, the size, shape, location, mobility and attachment of the mass must be assessed in combination with the patient's clinical findings [2]. Atrial enlargement, low cardiac output state, history of smoking, an EKG suggestive of an old anterior wall MI, presence of wall motion abnormality on an echo and atrial fibrillation are all suggestive of a thrombus [2]. In contrast, features that favor a tumor include the absence of history of coronary artery disease and a normal angiogram [2]. In our case 2, the regression of the mass after 1 year confirmed the initial echocardiographic impression of thrombus since spontaneous regression of cardiac tumor is highly unlikely.

Transthoracic echocardiography (TTE) is the first choice for the diagnosis of intracardiac masses, with transesophageal echocardiography (TEE) improving the accuracy [2]. However, its inability to visualize all cardiac chambers and reduced image quality in certain patients—arrhythmias, adiposity, congenital heart disease, suspected cardiac tumors, or right posterior ventricular thrombus, make it a less than ideal choice [7]. This is especially true when distinguishing normal myocardium from clots, as they both have similar echodensity and make it difficult to detect thin mural thrombi [7]. In addition, the gross appearance of cardiac thrombus being similar to a cardiac tumor, due to fibrin deposition, may make it difficult to identify it on an echocardiogram [2] [9].

Primary cardiac tumors are rare, occurring in 0.02% of autopsy series [2]. Myxomas and sarcomas are the most common primary tumors, with myxomas being curable by resection and sarcomas having a guarded prognosis regardless of treatment [2] [16]. Secondary cardiac involvement, either by direct invasion or hematogenous spread accounts about 9%, can lead to wall motion abnormality, arrhythmias, and heart failure [17] [18]. Metastatic involvement of the heart is seen with melanoma, lung cancer, breast cancer, non-Hodgkin lymphoma, and renal cell carcinoma [17] [18]. The right atrium is the most commonly affected chamber where 80% of the metastasis occurs [2], but in our first case, the metastatic lesion involved both the right and left ventricles with extension to the pericardium.

Table 1. Comparison table outlining key distinguishing features of cardiac mass and thrombi.

Features	Cardiac Thrombus	Cardiac Tumor
Pathogenesis	Typically arises from Virchow's Triad factors: endothelial damage, hemostasis, hypercoagulability	Primary tumors (e.g., myxomas, sarcomas) or metastatic spread from other cancers
Location	Commonly found in left cardiac chambers; less commonly in right chambers	Variable depending on tumor type and origin
Clinical Presentation	Often asymptomatic; incidental finding; can lead to embolism	Symptoms depend on tumor location, size, and effects on cardiac function
Echocardiography (TTE/TEE)	TTE may show a mobile mass with irregular shape and attachment to endocardium; TEE improves visualization but may still be challenging due to clot echodensity similar to myocardium	TTE/TEE may show heterogeneous mass with vascularity; TEE provides better detail on attachment and chamber involvement
Cardiac MRI	Thrombus lacks vascularization, appears as non-enhancing; may show as low signal intensity on T1 and T2-weighted images	Malignant tumors enhance with gadolinium due to vascularity; characteristic enhancement pattern helps differentiate from thrombi
CT Imaging	Thrombus may appear as filling defect without enhancement; CT angiography may aid in detection of associated embolism	Tumors often have distinct vascular patterns and enhancement on contrast CT; helps in assessing extent and involvement
Treatment	Anticoagulation for thrombi; surgery or chemotherapy/radiation for tumors depending on type and stage	Surgical resection for localized tumors; chemotherapy/radiation for metastatic or unresectable tumors
Prognosis	Favorable with appropriate anticoagulation; risk of embolism if untreated	Variable depending on tumor type, size, and stage; metastatic involvement often carries poorer prognosis

Cardiac computed tomography, contrast echocardiographic perfusion imaging and MRI are modalities used to differentiate cardiac masses [2]. MRI has excellent spatial resolution and superior soft tissue contrast, which enables it to characterize tissue composition, as well as assess the precise cardiac and extracardiac anatomy and the effects of the mass (**Table 1**) [2]. Malignant tumors are highly vascularized and will enhance with contrast, while cardiac thrombi will not due to their lack of vascularization [2] [3]. In our first patient, the cardiac mass enhanced with gadolinium, which favored the diagnosis of a malignant cardiac tumor, while the delayed enhancement of the mass on the cardiac MRI of the second patient was in favor of a cardiac thrombus.

Complete remission of intracardiac thrombosis is achieved in 75% of cases with anticoagulation [9]. Given the similar efficacy of drug therapy and surgery, as well as the convenience of the former, drug therapy needs to be chosen initially [19]. Others have previously warned against the use of thrombolytic agents in the case of mural thrombi, as these agents may dissolve the attached stalk and increase the risk of distal embolism of organized thrombi [6] [20]. Even though surgical resection always remains as an option in case of large mobile thrombus, persistence of thrombus despite optimal medical therapy and prior embolic events, the risk of recurrence and death is a major concern [9] [10]

5. Conclusion

Determination of the best approach for treatment of an intracardiac mass is challenging as it is tough to distinguish between an intracardiac thrombus and a mass. Due to the lack of early signs and symptoms of lung cancer that has metastasized to the heart, the diagnosis and treatment of this condition is also difficult. Cardiac MRI can be used to accurately differentiate between thrombi, vegetation, and tumors, and to assess the size, shape, location, composition, and potential for embolization of the mass. It can also be used to differentiate between benign and malignant tumors and can assess the degree of myocardial involvement and the presence of metastatic lesions.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Landman, C., Nahon, S., Cosnes, J., Bouhnik, Y., Brixi-Benmansour, H., Bouguen, G., *et al.* (2013) Portomesenteric Vein Thrombosis in Patients with Inflammatory Bowel Disease. *Inflammatory Bowel Diseases*, **19**, 582-589. https://doi.org/10.1097/mib.0b013e31827eea5f

[2] Baig, A., Borra, S., Moskovits, N., Sadiq, A. and Moskovits, M. (2011) Right Atrial Mass: A Diagnostic Dilemma. *Annals of the Academy of Medicine*, **40**, 100-101. https://doi.org/10.47102/annals-acadmedsg.v40n2p100

[3] Barbagallo, M., Naef, D., Köpfli, P., Hufschmid, U., Niemann, T., Gebker, R., *et al.*

(2021) Right Ventricular Thrombus, a Challenge in Imaging Diagnostics: A Case Series. *European Heart Journal—Case Reports*, **5**, ytab340. https://doi.org/10.1093/ehjcr/ytab340

[4] Bertina, R.M., Koeleman, B.P.C., Koster, T., Rosendaal, F.R., Dirven, R.J., de Ronde, H., *et al.* (1994) Mutation in Blood Coagulation Factor V Associated with Resistance to Activated Protein C. *Nature*, **369**, 64-67. https://doi.org/10.1038/369064a0

[5] Maccini, D.M., Berg, J.C. and Bell, G.A. (1989) Budd-Chiari Syndrome and Crohn's Disease. *Digestive Diseases and Sciences*, **34**, 1933-1936. https://doi.org/10.1007/bf01536715

[6] Lobo, A., Lewis, J.F. and Conti, C.R. (2000) Intracardiac Masses Detected by Echocardiography: Case Presentations and Review of the Literature. *Clinical Cardiology*, **23**, 702-708. https://doi.org/10.1002/clc.4960230914

[7] Kim, D.H., Il Choi, S., Choi, J., Chang, H., Choi, D., Lim, C., *et al.* (2006) Various Findings of Cardiac Thrombi on MDCT and MRI. *Journal of Computer Assisted Tomography*, **30**, 572-577. https://doi.org/10.1097/00004728-200607000-00004

[8] Mohan, B., Chhabra, S.T., Gulati, A., Mohan Mittal, C., Mohan, G., Tandon, R., *et al.* (2013) Clinical and Echocardiographic Diagnosis, Follow up and Management of Right-Sided Cardiac Thrombi. *Indian Heart Journal*, **65**, 529-535. https://doi.org/10.1016/j.ihj.2013.08.015

[9] Núñez-Cabarcas, E., López-Ruiz, N. and Ramírez-Rincón, A. (2014) Diagnostic Dilemma: Intracardiac Mass in a Woman with Behçet's Syndrome. *Archivos de Cardiología de México*, **84**, 273-275. https://doi.org/10.1016/j.acmx.2014.03.003

[10] Dinesh Kumar, U., Shetty, S., Sujay, K. and Wali, M. (2016) Left Ventricular Mass: A Tumor or a Thrombus Diagnostic Dilemma. *Annals of Cardiac Anaesthesia*, **19**, 728-732. https://doi.org/10.4103/0971-9784.191551

[11] Louw, V.J. and Ntusi, N.A.B. (2019) Virchow's Triad Revisited. *South African Medical Journal*, **109**, 822-823. https://doi.org/10.7196/samj.2019.v109i11.14442

[12] Casazza, F., Bongarzoni, A., Centonze, F. and Morpurgo, M. (1997) Prevalence and Prognostic Significance of Right-Sided Cardiac Mobile Thrombi in Acute Massive Pulmonary Embolism. *The American Journal of Cardiology*, **79**, 1433-1435. https://doi.org/10.1016/s0002-9149(97)00162-8

[13] Panidis, I.P., Kotler, M.N., Mintz, G.S. and Ross, J. (1984) Clinical and Echocardiographic Features of Right Atrial Masses. *American Heart Journal*, **107**, 745-758. https://doi.org/10.1016/0002-8703(84)90324-7

[14] Prior, A., Strang, F.A. and Whorwell, P.J. (1987) Internal Carotid Artery Occlusion in Association with Crohn's Disease. *Digestive Diseases and Sciences*, **32**, 1047-1050. https://doi.org/10.1007/bf01297197

[15] Razmeh, S., Niknam, N., Sadat Rabbani, N., Nikoee, S., Vafa Pour, F. and Taghavian, L. (2021) Cortical Vein Thrombosis after Infliximab Treatment for Crohn's Disease. *Neurology International*, **13**, 120-124. https://doi.org/10.3390/neurolint13010011

[16] Burke, A., Jeudy, J. and Virmani, R. (2008) Cardiac Tumours: An Update. *Heart*, **94**, 117-123. https://doi.org/10.1136/hrt.2005.078576

[17] Bahnson, H.T., Spencer, F.C. and Andrus, E.C. (1957) Diagnosis and Treatment of Intracapvitary Myxomas of the Heart. *Annals of Surgery*, **145**, 915-926. https://doi.org/10.1097/00000658-195706000-00013

[18] Lichtenberger, J.P., Reynolds, D.A., Keung, J., Keung, E. and Carter, B.W. (2016) Metastasis to the Heart: A Radiologic Approach to Diagnosis with Pathologic Cor-

relation. *American Journal of Roentgenology*, **207**, 764-772. https://doi.org/10.2214/ajr.16.16148

[19] Kinney, E.L. and Wright, R.J. (1989) Efficacy of Treatment of Patients with Echocardiographically Detected Right-Sided Heart Thrombi: A Meta-Analysis. *American Heart Journal*, **118**, 569-573. https://doi.org/10.1016/0002-8703(89)90274-3

[20] Finlayson, G.N. (2008) Right Heart Thrombi: Consider the Cause. *Canadian Journal of Cardiology*, **24**, 888. https://doi.org/10.1016/s0828-282x(08)70713-x