ORIGINAL ARTICLE
KLİNİK ARAŞTIRMA

Intracardiac masses in our routine practice: Evaluation with the literature

Rutin patoloji pratiğinde sık karşılaşılan intrakardiyak kitleler: Literatür eşliğinde değerlendirme

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Submitted Date: 19 March 2025**, Accepted Date:** 23 April 2025

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SUMMARY

Aim: Cardiac masses are rare and may be either neoplastic or non-neoplastic. This study aims to provide a comprehensive overview of cardiac masses and to evaluate their clinicopathological features.

Material and Methods: We retrospectively analyzed 35 cases of cardiac surgery performed at our institution between 2014 and 2022 for the presence of a cardiac mass.

Results: The patients' ages ranged from 7 months to 79 years (mean: 46.2 years), with a female-to-male ratio of 25:10. Primary benign cardiac tumors comprised the majority of cases. Myxoma was the most frequently observed tumor, followed by papillary fibroelastoma, fibroma, rhabdomyoma, and glomus tumor. Two cases of metastatic carcinoma were also identified. Non-neoplastic lesions were also common and included thrombus, calcified cardiac pseudotumor, and infective endocarditis, listed in decreasing order of frequency.

Conclusion: This study presents the clinical distribution and pathological characteristics of various cardiac masses observed in our institution, based on a relatively large case series.

Keywords: Cardiac masses, neoplastic, non-neoplastic lesions

ÖZET

Amaç: Kardiyak kitleler nadirdir, neoplastik ve non-neoplastik olarak ayrılmaktadır. Bu makalenin amacı kardiyak kitlelere genel bir bakış sağlamak ve klinikopatolojik özelliklerini gözden geçirmektir

Materyal ve Metodlar: Merkezimizde 2014-2022 yılları arasında kardiyak kitle nedeniyle opere edilen 35 vakayı retrospektif olarak inceledik.

Bulgular: Vakaların yaşları 7 ay ile 79 yıl arasında değişmektedir (ortalama yaş 46,2 yıl) ve 25'i kadındır. Serimizin büyük bir kısmını primer benign kalp tümörleri oluşturmaktadır ve en sık görülen tümöral lezyon miksoma olup, bunu sırasıyla fibroelastom, fibroma, rabdomyom ve glomus tümör izlemektedir. İki vaka metastatik karsinom tanılıdır. Non-neoplastik kitle lezyonları da çoğunlukta olup insidansına göre trombüs, kalsifiye kardiyak psödotümör ve infektif endokardit olarak sıralanmaktadır.

Sonuç: Bu çalışmada, çeşitli kardiak kitlelerin klinikopatolojik bulgularının bir arada değerlendirildiği geniş bir vaka serisi sunulmaktadır.

Anahtar kelimeler: Kardiak kitleler, tümörler, tümör dışı lezyonlar

Maltepe tıp derg. Cilt:17 Sayı:1/2025
https://doi.org/10.35514/mtd.2025.122

INTRODUCTION

Cardiac masses are uncommon, but they are significant causes of morbidity and mortality, as any intracardiac mass may lead to considerable hemodynamic or electrical disturbances (1). The clinical presentation is highly variable, generally depending on the location and size of the mass, and some lesions may also produce systemic symptoms (2). The main symptoms include sudden death, chest pain, heart failure, superior vena cava syndrome, valvular abnormalities, arrhythmias, and dyspnea. However, many cardiac tumors remain asymptomatic and are incidentally discovered (3).

Cardiac masses are broadly classified as neoplastic or non-neoplastic. Non-neoplastic lesions include thrombi, vegetations, calcific lesions, and rarer entities such as pericardial cysts. Neoplastic lesions are further divided into primary (benign or malignant) and metastatic tumors (4). Although myxoma was historically the most common primary benign cardiac tumor, papillary fibroelastoma (PFE) has become more frequently diagnosed in recent years, likely due to advancements in high-resolution imaging techniques (5). The most common primary malignant cardiac tumors are angiosarcoma, undifferentiated pleomorphic sarcoma, myxofibrosarcoma, and leiomyosarcoma. Unlike primary malignant tumors, metastatic involvement of the heart is relatively frequent (6).

Some non-neoplastic lesions—such as thrombi and infective endocarditis—can closely mimic true neoplasms, particularly myxomas (7). Given the rarity of both neoplastic and non-neoplastic cardiac masses, their evaluation often presents a diagnostic challenge. In this study, we aimed to retrospectively review the clinical, demographic, and pathological characteristics of cardiac masses encountered in our department.

MATERIAL AND METHODS

Cases with a preoperative diagnosis of cardiac mass that were surgically excised between 2014 and 2022 and subsequently diagnosed in our department were identified through archival review. Demographic and clinical data of the patients were retrieved from the hospital information system.

All specimens were fixed in formalin, routinely processed, and stained with hematoxylin and eosin. While some cases were diagnosed based solely on light microscopic evaluation, histochemical stains (such as Periodic acid-Schiff, Alcian Blue, and Masson Trichrome) and immunohistochemical studies were performed when necessary for diagnostic clarification.

This study was approved by the Ethics Committee of Istanbul Medipol University (Decision date: 16.03.2023, Decision No: E-10840098-772.02-1984) and conducted in accordance with the principles of the Declaration of Helsinki.

RESULTS

Over an 8-year period, a total of 35 cases were identified. Of these, 25 patients were female and 10 were male. The ages ranged from 7 months to 79 years, with a mean age of 46.2 years. The most common presenting symptom was dyspnea, while chest pain, syncope, fatigue, palpitations, fever, nausea, and vomiting were observed less frequently.

In our series, 24 cases were classified as neoplastic and 11 as non-neoplastic. Myxoma was the most frequently encountered neoplastic mass, whereas thrombus was the most common non-neoplastic lesion. Other neoplastic masses included papillary fibroelastoma (PFE), fibroma, rhabdomyoma, and glomus tumor. Additional non-neoplastic lesions were calcified amorphous pseudotumor (CAPT) and infective endocarditis (IE). Two patients were diagnosed with secondary (metastatic) cardiac tumors.

The distribution of diagnoses, clinical features, and basic histopathological findings is summarized in Table 1.

Myxomas were predominantly located in the left atrium; only one female patient had a tumor in the right atrium. Clinically, this patient did not exhibit any symptoms different from those seen in other myxoma cases. No familial myxoma cases were identified in our series. Histologically, all myxomas showed fusiform and polygonal cells embedded in an amorphous myxoid stroma (Figure 1).

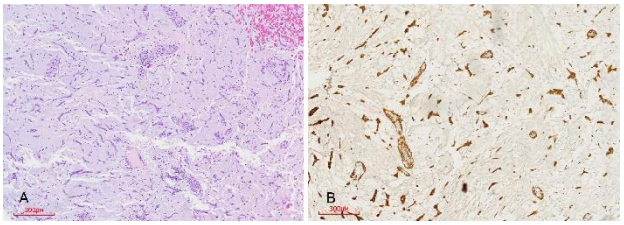

Figure 1. Myxoma; A) Myxoma cells in cord structure or around blood vessels. B) Calretinin positivity

Five cases were diagnosed as papillary fibroelastoma (PFE). In one patient, the mass was discovered during the evaluation of cardiac etiology following a cerebrovascular event. Histological sections of all cases revealed papillary structures with acellular, avascular stroma, covered by a single layer of endocardial cells (Figure 2).

Only one case of rhabdomyoma was detected. A baby girl was delivered via cesarean section after a cardiac mass was identified during the prenatal period. She was admitted to our hospital 20 hours after birth. Histopathological

Table 1. Distribution of diagnosis and clinicopathologic features.

	Number (%)	Age range	Gender F/M	Symptoms	Diameter of the mass	Localisation	Basic morphologic findings
Non-neoplastic	11 (33.4%)						
Thrombus	7 (21.2%)	4-74 (34.6)	5/2	Dyspnea, chest pain, weakness	Varying between 1.5 cm and 5 cm	Right atrium (6 case) Left atrium (1 case)	Hemorrhagic areas, fibrin accumulations
Calcified amorf pseudotumor	2 (6.1%)	66 and 79	2/0	Fainting	1 cm and 3.5 cm	Right ventricle and right atrium	Nodular calcification, eosinophilic amorphous material
Infective endocardit	2 (6.1%)	7 months and 51 years	1/1	Fever	2 cm and 3 cm	Right atrium and tricuspid valve	Numerous bacterial colonies and neutrophils enmeshed in fibrin
Neoplastic	24 (68.6%)						
Primary benign tumors	22 (62.8%)						
Myxoma	13 (37.2%)	38-74 (55.1)	11/2	Dyspnea, palpitations, dizziness, fatigue	Varying between 3 cm and 6 cm	Left atrium (12 case) Right atrium (1 case)	Stellate, ovoid, or spindle-shaped cells in abundant matrix. Hemosiderin-laden macrophages, hemorrhage, fibrinoid necrosis and inflammatury cells in the stroma
Papillary fibroelastoma	5 (14.3%)	35-57 (45)	3/2	Dyspnea, chest pain	Varying between 0.6 cm and 2 cm	Left artium (1 case) Tricuspit valve (1 case) Mitral valve (3 case)	Numerous branching papillary fronds, each fronds composed of an avascular core of hyalinized hypocellular stroma with elastic fibers
Fibroma	2 (5.7%)	1 and 10 months	1/1	murmur and echocardiography abnormality	2.5 cm and 4.8 cm	Right ventricle and right atrium	Spindle cells in a collagenous background
Rabdomyoma	1 (2.8%)	1 months	1/0	Detected in the intrauterine period	4 cm	Right ventricle	Large vacuolated cells with abundant glycogen so called spider cells
Glomus tumour	1 (2.8%)	57	1/0	chest pain	3.5 cm	Right ventricle	composed of 3 components: glomus cells, vasculature, and smooth muscle cells
Secondary tumors (metastasis)	2 (5.7%)						
Metastatic carcinoma	2 (5.7%)	65 and 78 years	0/2	Detected during scanning	4.5 cm and 3.5 cm	Right atrium and right ventricle	malignant epithelial tumor with glandular differentiation or mucin production
Total	35 (100%)		25/10				

examination showed large, polygonal, clear cells containing glycogen vacuoles. No mitotic figures were observed. Immunohistochemically, the tumor cells were positive for smooth muscle actin (SMA) and desmin. Histochemically, intracytoplasmic positivity with periodic acid-Schiff (PAS) was also noted (Figure 3). Unfortunately, the patient died 10 days postoperatively due to sepsis.

Two cases of fibroma were identified in infants. One was a 10-month-old infant who presented with vomiting. A cardiac murmur was detected during examination, and echocardiography revealed a 2.5 × 2.5 cm mass in the right atrium. The other was a 34-day-old infant with a 4.8 × 4.4 cm mass originating from the right ventricular wall, as shown on echocardiography. In both cases, microscopic examination confirmed fibroma, composed of spindle cells in a collagenous stroma. Immunohistochemically, smooth muscle actin (SMA) showed a tram-track pattern of

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https://doi.org/10.35514/mtd.2025.122

positivity. Masson's trichrome staining demonstrated a clear boundary between the fibroma (blue) and the adjacent normal myocardium (red) (Figure 4).

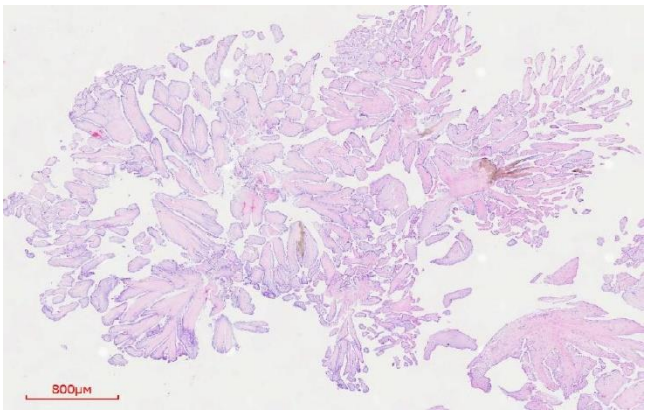

Figure 2. Papillary fibroelastoma; Avascular tumor fronds growing into a cardiac chamber.

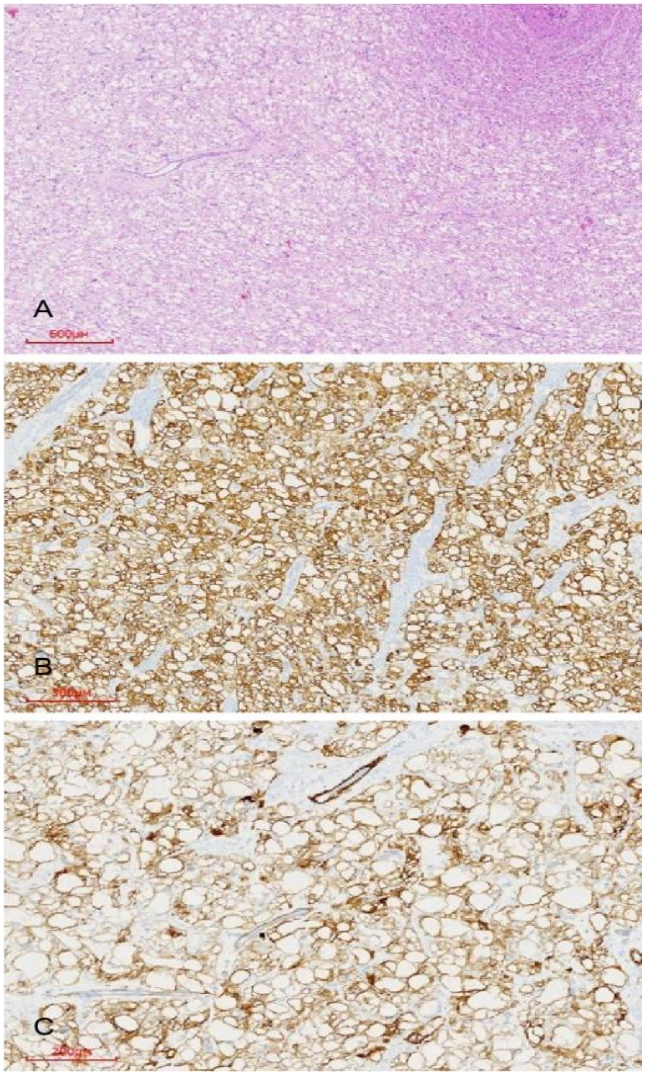

Figure 3. Rhabdomyoma; A) The tumor is composed of a uniform population of round and polygonal cells with focal cytoplasmic vacuolization. B) SMA C) Desmin.

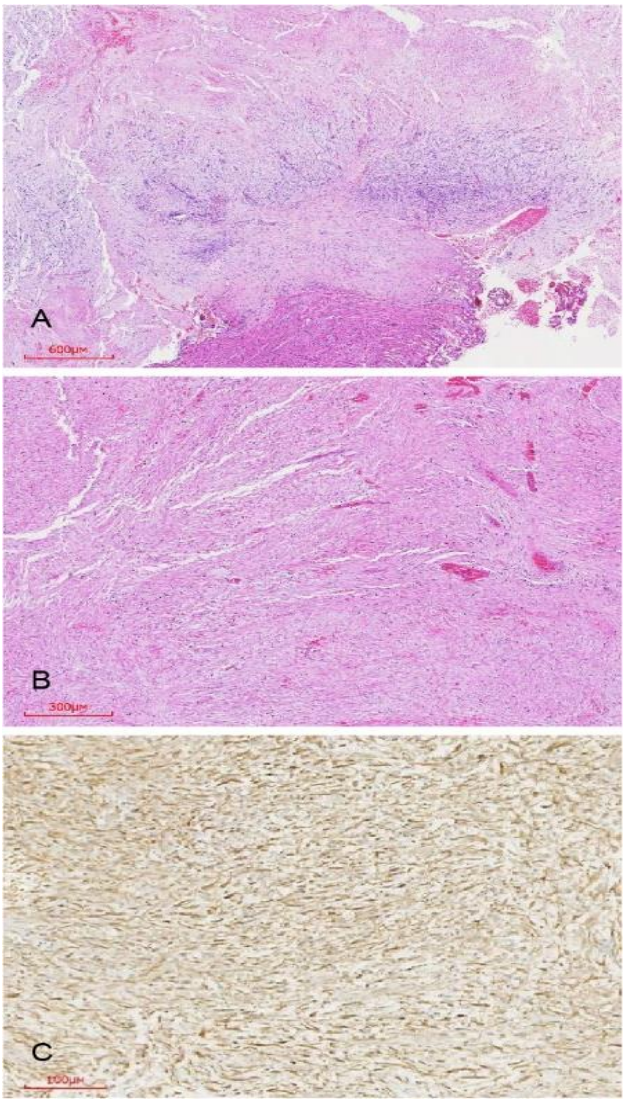

Figure 4. Fibroma; A-B) Cardiac fibromas are composed of bland fibroblastic cells in a dense collagenous stroma. C) Immunohistochemical SMA positivity in the tumor.

A 57-year-old female patient was diagnosed with a glomus tumor. She presented with chest pain, and a mass was subsequently detected at the outflow tract of the right ventricle. The mass, measuring 3.5 × 2.5 × 1.5 cm, was excised with a preliminary diagnosis of myxoma. Grossly, the tumor appeared semisolid and was encapsulated. Histological examination revealed a well-circumscribed lesion composed of glomus cells, endothelial cells, and smooth muscle cells. Immunohistochemically, endothelial cells were positive for CD34, glomus cells were positive for smooth muscle actin (SMA), while CD31 was negative. Ki-67 staining showed no proliferative activity, and no necrosis was observed. These features were consistent with a diagnosis of glomus tumor (Figure 5).

Thrombus was diagnosed in seven patients. Six of them had right atrial masses, and one had a left atrial mass. Two of these patients had an initial clinical diagnosis of myxoma. All patients had underlying medical conditions,

including chronic renal failure (2 patients), nephrotic syndrome (1 patient), oral contraceptive use (1 patient), congestive heart failure (1 patient), history of atrial septal defect repair (1 patient), and coronary artery stenting (1 patient). Histologically, the thrombi were composed predominantly of fibrin/platelet aggregates, red blood cells, and white blood cells (Figure 6).

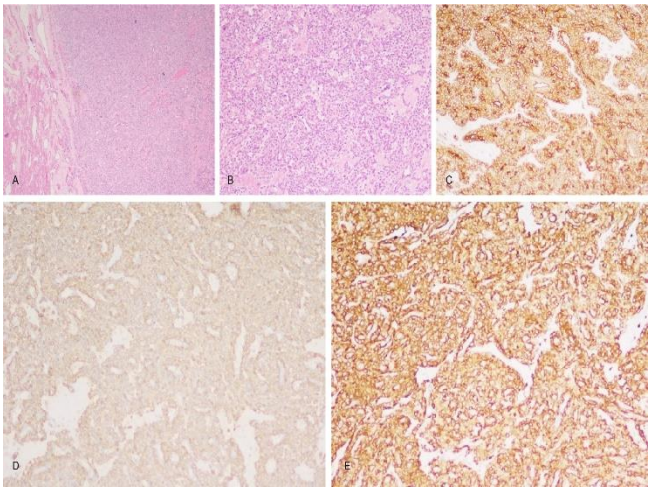

Figure 5. Glomus tumour; A-B) The tumour well circumscribed and show sheets of cells. The tumor cells are round and regular with uniform circular nuclei. C) CD34 (X100), D) SMA (X100) E) CALDESMON (X100).

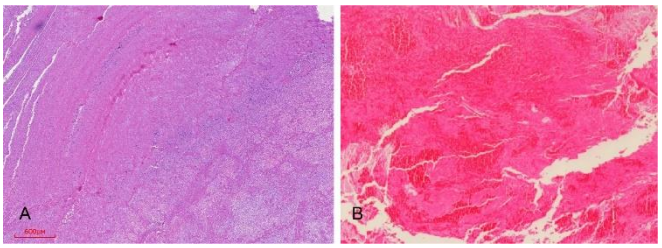

Figure 6. Thrombus; A-B) well-organized thrombus with centrally located red blood cells/hemorrhagic areas (arrows) and surrounding fibrin accumulations (dotted arrows).

Calcified amorphous pseudotumor (CAPT) of the heart was identified in two female patients aged 66 and 79, both of whom presented with syncope. Histopathological examination of the lesions revealed nodular calcium deposits embedded within fibrinous material (Figure 7).

Infective endocarditis was diagnosed in two patients. In the first case, a 7-month-old infant presented with persistent high fever. Imaging revealed an intracardiac mass, and follow-up echocardiography showed an increase in the size of the mass, which began to prolapse through the tricuspid valve. Blood cultures grew coagulase-negative Staphylococcus. Microscopic examination demonstrated bacterial colonies embedded in fibrin, and a diagnosis of acute bacterial endocarditis was made.

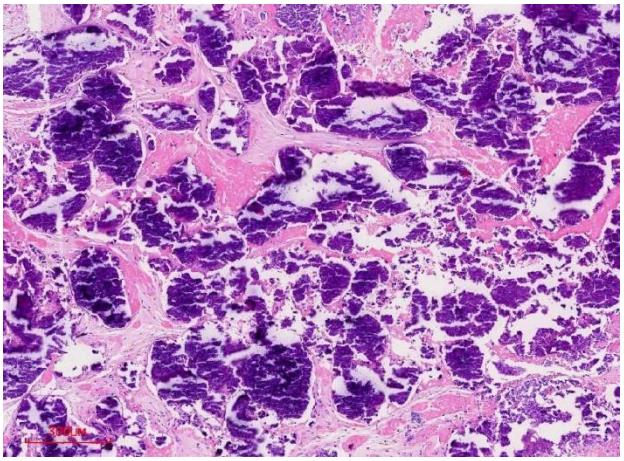

Figure 7. Calcified amorphous tumor; Nodular calcified amorphous debris with admixed degenerated fibrin.

The second case involved a 56-year-old female patient with a history of chronic myeloid leukemia that had transformed into acute myeloid leukemia. During follow-up, a 2 × 2 cm mobile mass was detected on the tricuspid valve. Blood cultures repeatedly yielded Klebsiella species. A diagnosis of infective endocarditis was confirmed based on histopathological findings and positive blood culture results (Figure 8).

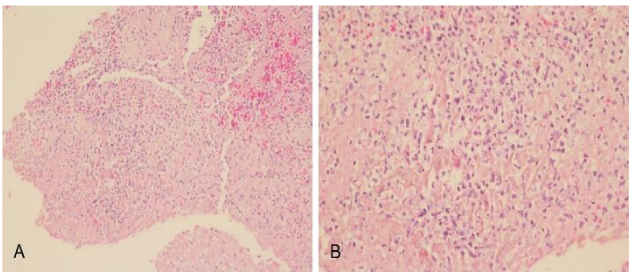

Figure 8. Infective endocardit; A-B) neutrophils, fibrin and bacterial colonies.

Two cases of metastatic carcinoma were identified in this series. The first case involved a 65-year-old male patient with a known diagnosis of colon carcinoma. During follow-up, a mass was detected in the right atrium along with a thrombus in the inferior vena cava. Surgical resection of the right atrial tumor and excision of the inferior vena cava thrombus were performed. Microscopically, the tumor displayed cribriform glands filled with necrotic debris. Immunohistochemically, the tumor was negative for CK7, showed focal positivity for CK20, and was diffusely positive for CDX2, supporting the diagnosis of metastatic colon carcinoma.

The second case was a 78-year-old male patient who presented with sudden loss of consciousness. Imaging revealed masses in both the brain and the lung, as well as a right ventricular mass, which was initially presumed to be a thrombus and surgically excised. Histopathological examination revealed solid adenocarcinoma composed of

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sheets of neoplastic cells containing intracytoplasmic mucin. Immunohistochemically, the tumor was positive for CK7 and negative for CK20 and TTF-1. These findings suggested a pulmonary primary tumor. Notably, in this case, the initial diagnosis of malignancy was established based on the cardiac mass (Figure 9).

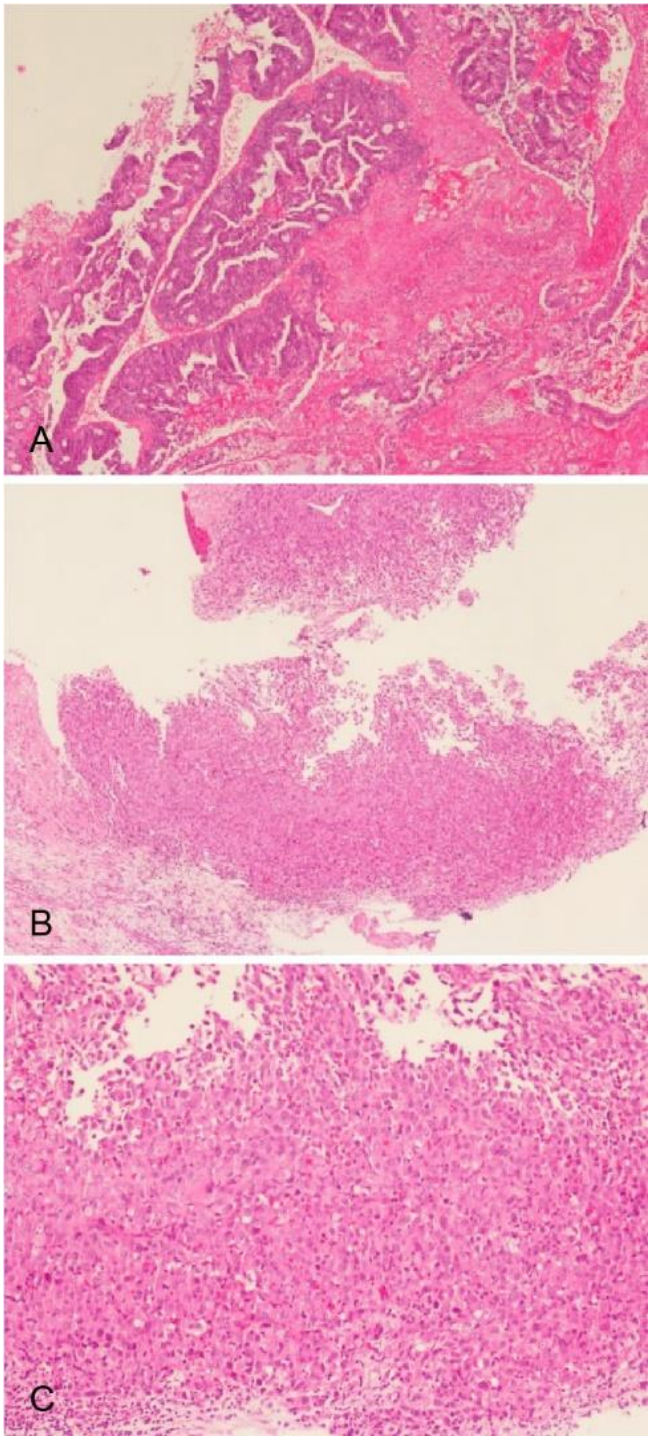

Figure 9. Metastatic carcinoma: A) colorectal cancer is a well-to-moderately differentiated adenocarcinoma consisting of tubuler, anastomosing and branching glands. B-C) Metastatic solid adenocarcinoma.

DISCUSSION

Cardiac masses include primary benign and malignant tumors, secondary (metastatic) tumors, and tumor-like non-neoplastic lesions (2). Primary cardiac tumors are rare, while metastatic tumors are reported to be 20 to 30 times more common than primary ones (8). The vast majority of primary cardiac tumors are benign. Although myxoma was historically considered the most common primary cardiac tumor, papillary fibroelastoma (PFE) is now recognized as more prevalent due to improved imaging techniques (5). Non-neoplastic lesions—such as thrombi, hamartomas, and reactive proliferations—can mimic neoplastic processes both clinically and pathologically (4).

Cardiac myxomas typically occur in middle-aged women and most commonly originate from the interatrial septum. The most frequent site of involvement is the left atrium, followed by the right atrium and ventricles (2,9). In our study, the number of female patients was five times higher than that of males. The majority of myxomas were located in the left atrium, consistent with the literature, with only one case identified in the right atrium. Left atrial myxomas may cause mitral valve obstruction, leading to symptoms such as dyspnea and orthopnea. In line with this, the main presenting symptom in our series was dyspnea.
In contrast, right atrial myxomas may present with signs of right-sided heart failure (10). Additionally, cardiac myxomas can initially manifest with embolic complications, such as stroke, syncope, chest pain, limb ischemia, or soft tissue masses in the distal extremities (11). In our series, one patient was diagnosed with a 5.5 × 2.5 cm left atrial mass during evaluation for stroke etiology, which was confirmed as a myxoma following surgical excision.

On microscopic examination, cardiac myxomas are characterized by stellate, ovoid, or spindle-shaped cells—referred to as myxoma cells—embedded in a vascular myxoid stroma. These cells may appear singly or in clusters. When clustered, they can form cords, nests, or ring-like structures. This histological feature is considered pathognomonic and is particularly helpful in differentiating myxomas from organizing thrombi. The stroma often shows prominent hemorrhage, hemosiderin-laden macrophages, fibrinoid necrosis, and inflammatory infiltrates. Thick-walled vessels, usually one or two, are commonly seen at the base of the lesion (9).

In our series, ring structures were identified in 41.6% of cases during microscopic evaluation. No mitotic figures were observed; however, the presence of mitosis should raise suspicion for malignancy. Cardiac myxomas can be readily diagnosed based on their typical histopathological features and classical anatomical locations. For confirmation, we used calretinin immunohistochemistry, which is strongly and diffusely positive in myxomas. Calretinin is a valuable marker for differentiating myxomas

from myxosarcomas, which are typically negative (12).

Approximately 90% of cardiac myxomas occur sporadically, while about 10% arise as part of Carney complex—a hereditary syndrome characterized by cardiac and extracardiac myxomas, endocrine abnormalities such as Cushing's syndrome or acromegaly, and spotty skin pigmentation (9). All of our cases were sporadic; no familial or syndromic cases were identified.

Cardiac papillary fibroelastoma (PFE) is now recognized as the most common primary cardiac tumor. There are various theories regarding its etiology, including hypotheses that PFEs may represent true neoplasms, hamartomas, reactive proliferations, organizing thrombi, or posttraumatic lesions. Although PFE was historically considered a tumor-like lesion, recent studies have demonstrated that a subset of PFEs harbour canonical oncogenic driver mutations, particularly in the KRAS gene, supporting their neoplastic nature (13).

PFEs most frequently arise from the valvular endocardium (80–90%), with the aortic valve being the most common site, though they may also originate from other endocardial surfaces within the atria and ventricles (14). In our series, three cases involved the mitral valve, one the aortic valve, and one the tricuspid valve. Three of the patients were female and two were male. The most common presenting symptom was dyspnea; one patient also experienced chest pain.

In two retrospective studies, neurological symptoms—particularly transient ischemic attacks or strokes—were reported as the most frequent clinical presentations, occurring in approximately 30% of patients with PFE (14,15). Similarly, one of our patients presented with syncope and was diagnosed with cerebrovascular disease. Further investigation revealed a 2 × 2 cm mass in the left atrium, which was diagnosed as PFE after surgical resection. In contrast, PFEs may be detected incidentally in up to one-third of patients (4).

Microscopically, PFEs are characterized by multiple branching, leaf-like projections composed of avascular fibroelastic tissue, lined by a single layer of endocardial cells (16). All cases in our series exhibited these typical histological features.

Rhabdomyomas are the most common benign pediatric cardiac tumors, followed by cardiac fibromas (17). Both may occur sporadically or in association with tumor syndromes—particularly tuberous sclerosis for rhabdomyomas and Gorlin syndrome for fibromas (18,19). In our series, there were five pediatric cases, including one rhabdomyoma and two fibromas. None of the patients exhibited features suggestive of an underlying tumor syndrome.

Cardiac rhabdomyomas are composed of large, vacuolated cells rich in glycogen, often referred to as "spider cells." This appearance is due to a centrally located nucleus from which myofibrils radiate toward the cell membrane. These cells are strongly positive with periodic acid–Schiff (PAS) staining due to their glycogen content.

Cardiac fibromas consist of monomorphic fibroblasts exhibiting minimal or no atypia. The tumor margins tend to infiltrate into the adjacent myocardium. Cellular density typically decreases with the patient's age, while the amount of collagen increases. Mitotic activity is generally observed only in tumors occurring during infancy. Additionally, occasional perivascular lymphocytic and histiocytic aggregates or mild chronic inflammation may be present at the interface between the tumor and uninvolved myocardium (20).

Glomus tumors are rare, benign vascular neoplasms of smooth muscle cell origin, most commonly found in the skin. They can be subclassified into solid glomus tumors, glomangiomas, or glomangiomyomas, depending on the proportion and arrangement of vascular structures, smooth muscle cells, and glomus cells (21). When severe cytologic atypia, increased mitotic activity (>5 mitoses per 50 high-power fields), or atypical mitoses are present, the lesion is designated as a malignant glomus tumor (glomangiosarcoma) (22).

To date, only nine cases of cardiac glomus tumors have been reported in the literature. The first case was described by Masson in 1924 (23). Among these, seven were benign and two were malignant (22,24). In one case, multiple foci of cardiac glomus tumors were identified (21). Our case likely represents the tenth reported case of an intracardiac glomus tumor in the literature.

Thrombus is one of the most common types of cardiac masses and may clinically mimic primary cardiac neoplasms such as myxomas (25). It may also coexist with neoplastic cardiac masses (26). Thrombi are composed of variable amounts of erythrocytes, fibrin, and platelets, and can either adhere to the endocardial surface or float freely within the cardiac chambers. They are frequently associated with structural heart disease or the presence of intracardiac devices.

Calcified amorphous pseudotumor (CAPT) of the heart is a rare entity. Histologically, it consists of calcification and eosinophilic amorphous material within a dense collagenous fibrous background. Some reports suggest that CAPT may represent a calcified stage of an organizing thrombus, indicating that these two entities could be part of the same pathological spectrum (4).

In our series, thrombus was the most common non-neoplastic lesion. Seven cases were diagnosed as thrombus, and two as CAPT. Clinical evaluation for thrombus etiology revealed several associated conditions, including nephrotic syndrome, oral contraceptive use,

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congestive heart failure, prior coronary stent placement, and a history of atrial septal defect repair.

Infective endocarditis (IE) is an infection of the endocardial surfaces of the heart and is considered a potentially life-threatening condition. Radiologically, IE can mimic a cardiac mass. It has been reported that IE most commonly resembles cardiac myxoma, and in some cases, myxomas may be misdiagnosed as infective endocarditis. However, histological evaluation allows for a clear distinction between these two entities (27).

Recognized risk factors for IE include a history of prior infective endocarditis, the presence of prosthetic heart valves or intracardiac devices, valvular or congenital heart disease, intravenous drug use, indwelling intravenous lines, immunosuppression, and recent dental or surgical procedures (28).

In our series, two patients were diagnosed with infective endocarditis, one of whom was immunosuppressed due to acute myeloid leukemia.

Metastatic tumors are significantly more common than primary cardiac tumors (29). However, the exact incidence of cardiac metastasis remains uncertain, as it is mostly derived from autopsy studies. This is likely because cardiac metastases often occur in the setting of advanced (stage IV) disease, and many patients die before a cardiac metastasis is clinically diagnosed (30). The most common primary sources of cardiac metastasis are lung carcinomas (35–40%) and breast carcinomas (approximately 10%), followed by hematologic malignancies (10–20%) (31). Colorectal cancer rarely metastasizes to the heart; its prevalence in autopsy series ranges from 1.4% to 2%, and when it does occur, it most commonly involves the pericardium. In our series, two cases of metastatic carcinoma were identified: one was metastatic colon adenocarcinoma, and the other was a poorly differentiated adenocarcinoma, likely of pulmonary origin.

A multicenter study from Turkey reported 40 cases of cardiac masses over a 10-year period, of which 35 were benign (including benign tumors and hydatid cysts), and 5 were malignant (32). In that study, myxoma was the most common benign tumor, but the presence of hydatid cysts was also noteworthy. Among the malignant lesions, there were two cases of lymphoma, one angiosarcoma, one leiomyosarcoma, and one metastatic squamous cell carcinoma.

In the present study, we retrospectively analyzed 35 consecutive cases of cardiac masses. To the best of our knowledge, this constitutes one of the largest single-center series to date that includes such a diverse range of neoplastic and non-neoplastic cardiac lesions.

Author Contributions: Working Concept/Design: EK, Data Collection: EK, Data Analysis / Interpretation: EK, Text Draft: EK, AC, Critical Review of Content: AC, OY, SD, Last Proof and Responsibility: EK, SD, Supervision: OY, SD
Conflict of Interest: The authors state that there is no conflict of interest regarding this manuscript.
Financial Disclosure: The authors declared that this

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Maltepe tıp derg. Cilt:17 Sayı:1/2025
https://doi.org/10.35514/mtd.2025.122