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Surgical Treatment of Intracardiac Masses: A Single Center Experience

İntrakardiyak Kitlelerin Cerrahi Tedavisi: Tek Merkez Deneyimi

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Abstract

Objective: Intracardiac masses are highly rare and challenging to diagnose and treat. Surgical resection is typically the only treatment option for most simple primary cardiac masses upon diagnosis. In this retrospective study, we provided our clinical experience, surgical technique, and early and midterm outcomes for patients who underwent surgery for intracardiac mass.

Materials and Methods: Ten patients who underwent surgical treatment in our department because of an intracardiac mass over a three-year period were included in the study. Under general anesthesia, all surgeries were conducted electively by median sternotomy.

Results: The mean age of the patients was 61.8±15.25 years. In eight patients, a left atriotomy was performed, whereas two individuals underwent a right atriotomy. Mitral valve replacement was the most prevalent concomitant procedure (n=3, 30%), followed by coronary artery bypass grafting (n=2, 20%) and patent foramen ovale repair (n=1, 10%). Two patients died from non-cardiac causes during the early postoperative period. The median follow-up duration was 45.57 months and during the follow-up period, no patient experienced a recurrence.

Conclusions: Cardiac masses can present with various clinical symptoms, and when required, successful surgical excision with low morbidity and mortality can be performed with the help of preoperative advanced imaging techniques and careful clinical evaluation.

Keywords
Intracardiac, mass, surgery

Anahtar Kelimeler
İntrakardiyak, kitle, cerrahi

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Öz

Amaç: İntrakardiyak kitleler oldukça nadir olup tanı ve tedavisi zordur. Cerrahi rezeksiyon, tanı konulduktan sonra basit primer kardiyak kitlelerin çoğunluğu için tek tedavi seçeneğidir. Bu retrospektif çalışmada intrakardiyak kitle nedeniyle cerrahi tedavi uygulanan hastalarda klinik deneyimimizi, cerrahi tekniğimizi, erken ve orta dönem sonuçlarımızı sunmayı amaçladık.

Gereç ve Yöntemler: Çalışmaya üç yıllık süre içinde intrakardiyak kitle nedeniyle kliniğimizde cerrahi tedavi uygulanan 10 hasta dahil edildi. Tüm ameliyatlar genel anestezi altında, elektif olarak, medyan sternotomi ile yapıldı.

Bulgular: Hastaların yaş ortalaması 61,8±15,25 yıl idi. Sekiz hastada sol atriyotomi, iki hastada sağ atriyotomi yapıldı. Mitral kapak replasmanı en yaygın eşlik eden prosedürdü (n=3, %30), bunu koroner arter baypas greftleme (n=2, %20) ve patent foramen ovale onarımı (n=1, %10) izledi. Ameliyat sonrası erken dönemde iki hasta kalp dışı nedenlerle kaybedildi. Medyan takip süresi 45,57 aydı ve takip süresi boyunca hiçbir hastada nüks görülmedi.

Sonuç: Kardiyak kitleler çok çeşitli klinik semptomlarla karşımıza çıkabilmekte ve gerektiğinde preoperatif ileri görüntüleme teknikleri ve dikkatli klinik değerlendirme ile düşük morbidite ve mortalite ile başarılı cerrahi eksizyon yapılabilmektedir.

Introduction

Intracardiac masses are remarkably rare and difficult to manage. Cardiac masses are comprised of primary and secondary tumors, thrombotic, infectious, and congenital. Primary cardiac tumors are likewise infrequent, with an estimated incidence of 0.001% to 0.3% in large autopsy series (1). Few of these tumors are malignant, whereas the most are benign. Myxomas account for the majority of benign tumors, followed by papillary fibroelastomas and fibromas. Primary malignant heart tumors are mostly sarcomas with angiosarcoma and undifferentiated sarcomas being the most frequent (2,3). Although most cases of primary cardiac tumors are sporadic, some cases based on genetics, such as myxomas, have been reported. Carney complex, a familial syndrome linked to a mutation in the *PRKAR1A* gene, accounts for 3-10% of cardiac myxomas (4). Sporadic cardiac myxomas develop 2-4 times more frequently in women than in men and are most typically located in the left atrium (5).

Due to its stealthy beginning, the clinical presentation of cardiac masses poses a significant diagnostic problem. Depending on the affected area and size of the lesion, patients present with a variety of symptoms, including dyspnea, heart failure, embolic events, and rhythm problems (5). Medical history, physical examination, echocardiographic data, laboratory results, and radiographic imaging are used to make a diagnosis in patients with intracardiac masses. Transthoracic echocardiography (TTE), transesophageal echocardiography (TEE), magnetic resonance imaging (MRI), and computed tomography (CT) are the four most common imaging modalities used to make differential diagnosis of cardiac masses. Upon diagnosis, surgical resection is frequently the sole therapeutic option for the majority of simple primary cardiac tumors.

In this retrospective study, we aimed to present our clinical experience, surgical strategy and early and mid-term outcomes of patients who were operated on for intracardiac mass over a 3-year period.

Materials and Methods

The study included 10 patients who underwent cardiac surgery in our department due to an intracardiac mass between January 2017 and December 2019. The study was carried out retrospectively by collecting the patients' demographic data and clinical parameters as well as operative details from hospital records. An experienced cardiologist performed TTE on all of the patients. The Cardiology - Cardiovascular Surgery Council decided on the operation based on the echocardiographic recordings and the clinical and comorbid characteristics of the patients.

Patients with angina, impaired left ventricular (LV) systolic function, objective evidence of ischemia, history of coronary artery disease, or coronary risk factors (including males over 40 years old and postmenopausal women) were scheduled for coronary angiography prior to surgery. Coronary angiography is crucial for showing the feeding artery in cardiac masses as well as providing information regarding coronary artery disease. Genetic screening was not performed in patients diagnosed with myxoma.

The study protocol was approved by the Local Ethics Committee of the Selçuk University Medical Faculty (Approval number: 2022/267 and approval date: 24.05.2022). Each patient signed a written informed consent form. The study was performed in conformity with the Declaration of Helsinki's principles.

Echocardiographic Assessment

In this study all patients underwent transthoracic echocardiographic examination by Vivid E9 (Vivid E9, GE Healthcare, Milwaukee, Wisconsin) echocardiography device with a 1.5-4.5 MHz transducer. TEE was performed using GE Vivid i echocardiography device with a 3.0-8.0 MHz transducer (GE Healthcare, Milwaukee, Wisconsin). All echocardiographic examinations were performed by the same experienced operator. Ejection fraction, LV end-systolic, and end-diastolic diameters, valvular regurgitations and specific features of cardiac masses were noted.

Surgical Procedure

All procedures were performed electively via median sternotomy under general anesthesia. Following aorto-bicaval cannulation, caval snares were placed around both vena cava, cardiopulmonary bypass was initiated and moderate hypothermia was chosen. To prevent systemic embolization, the heart was minimally manipulated prior to aortic cross-clamping at this stage of the operation. After the aorta was cross-clamped, cold blood cardioplegia was administered to achieve diastolic cardiac arrest.

Patients with right atrial mass underwent right atriotomy (n=2, 20%) while those with left atrial mass underwent left atriotomy (n=8, 80%) via the interatrial groove (Figure 1). The pedicle of the mass was resected with a wide excision together with the attached endocardial tissue. Efforts were made to remove the masses in a gentle, non-crumbling manner. It was found that the removed masses ranged in size from approximately 2.5 to 8 centimeters (Figure 2). The excised masses were transported under suitable conditions to the Department of Pathology for evaluation. Following mass removal, the heart cavities were irrigated with cold isotonic sodium chloride carefully. The incisions (left/right atriotomy) were then closed with a continuous suturing technique. Three patients underwent concomitant mitral valve replacement, two had coronary artery bypass grafting surgery, and one had patent foramen ovale closure. Following appropriate de-airing techniques, the aortic cross clamp was removed. All surgical procedures were accomplished without any complications.

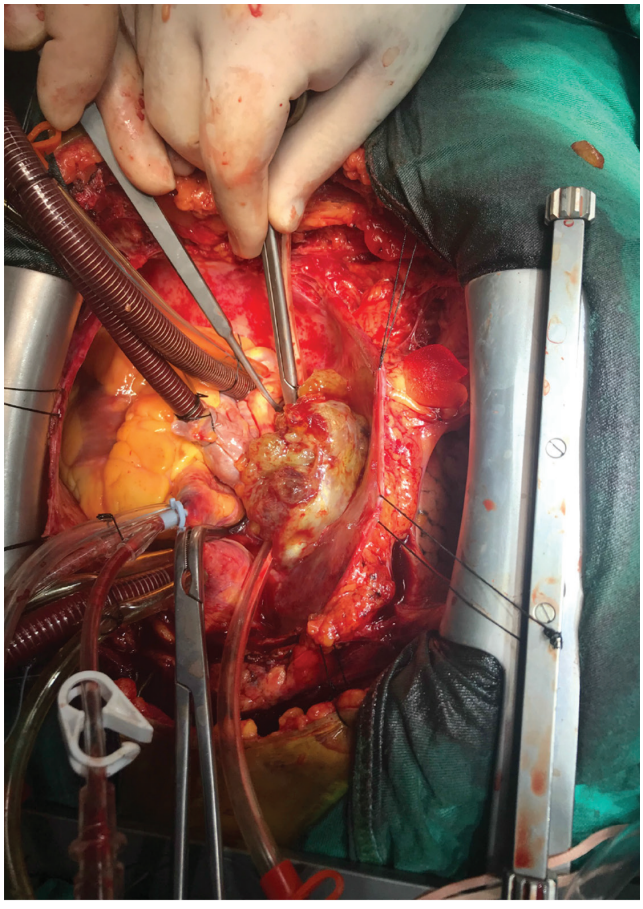


Figure 1. Following left atriotomy, a huge intracardiac mass appeared

Statistical Analysis

IBM SPSS Statistics for Windows, version 22.0 (IBM Corp., Armonk, N.Y., USA) was used to conduct statistical analysis. For normally distributed variables, mean and standard deviation were used, whereas for data with a non-normal distribution, median and interquartile ranges were employed. Nominal variables were expressed as a number and a percentage. Using the Kolmogorov-Smirnov test, a normality analysis was performed.

Results

The demographic, clinical and echocardiologic characteristics of the patients are presented in Table 1. The mean age of the patients included in the study at the time of diagnosis was 61.8±15.25 years. The majority of the patients (n=9, 90%) were female. The most prevalent symptom was dyspnea (n=6, 60%), while angina, palpitation and stroke were reported in 2, 1 and 2 individuals, respectively. TTE was used to evaluate all patients. However, 4 (40%) patients also underwent TEE, and 3 (30%) underwent MRI. Eight (80%) patients who met the criteria outlined in the Material and Methods section had coronary angiography prior to surgery.

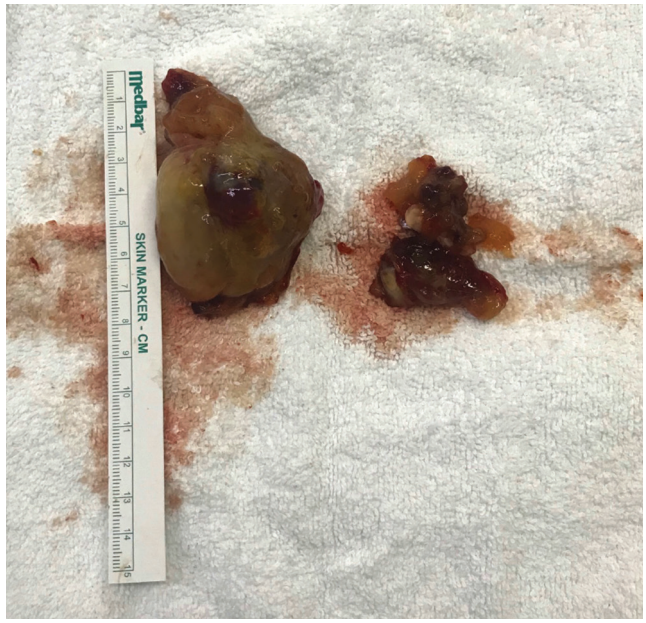


Figure 2. The resected intracardiac mass measured 8 centimeters in length

Table 2 details the surgical and postoperative data of the patients. The most common concomitant procedure was mitral valve replacement (n=3, 30%), followed by coronary artery bypass grafting (n=2, 20%) and patent foramen ovale repair (n=1, 10%). The mean time for X-clamp and cardiopulmonary bypass was 50.9±24.63 and 70.1±31.23 minutes, respectively. Only one patient had a positive inotrope need following surgery. Intensive care unit length of stay was 2 days (1.75-7) [median (25-75 percentile)], whereas hospital length of stay was 9.5 days (7-17.5) [median (25-75 percentile)]. The median follow-up duration was 45.57 months. None of the patients suffered a recurrence over the time of follow-up. Two patients died in the hospital after surgery. One of the patients was 88 years old, had chronic renal failure, and was in poor general condition before the procedure. She died on the 12th postoperative day due to non-cardiac reasons. The other patient who died at the hospital was 75 years old and her general condition was poor before the operation. This patient also underwent mitral valve replacement and coronary artery bypass grafting surgery in addition to the intracardiac mass excision. The patient died on the 14th postoperative day due to respiratory failure. Two patients died during follow-up period. One of the patients had chronic obstructive pulmonary disease and died as a result of it and the other patient died 52 months after surgery from complications related to dialysis.

Table 3 summarizes the related cardiac structure, localization, and histopathologic diagnosis of the resected cardiac masses. The most common

Table 1. The demographic and echocardiologic characteristics of the patients

	Patients (n=10)
Male	1 (10%)
Age (years)	61.8±15.25
Symptoms Dyspnea Angina Palpitation Stroke	 6 (60%) 2 (20%) 1 (10%) 2 (20%)
Hypertension	6 (60%)
Diabetes mellitus	4 (40%)
Chronic renal failure	2 (20%)
Previous systemic embolism	2 (20%)
Body mass index (kg/m^2)	29.75±5.72
Preoperative rhythm Normal sinus rhythm Atrial fibrillation	 9 (90%) 1 (10%)
Imaging modality Transthoracic echocardiography Transesophageal echocardiography Magnetic resonance imaging	 10 (100%) 4 (40%) 3 (30%)
Preoperative coronary angiography	8 (80%)
Left ventricular ejection fraction (%)	57.2±3.12
Systolic pulmonary artery pressure (mmHg)	35.2±10.58
Left ventricular end-diastolic diameter (mm)	47±3.94
Left ventricular end-systolic diameter (mm)	29.7±2.41

Table 2. Operative and postoperative characteristics of the patients

	Patients (n=10)
Concomitant procedures Mitral valve replacement Coronary artery bypass grafting Patent foramen ovale repair	 3 (30%) 2 (20%) 1 (10%)
Surgical approach Left atriotomy Right atriotomy	 8 (80%) 2 (20%)
X-clamp time (minutes)	50.9±24.63
Cardiopulmonary bypass time (minutes)	70.1±31.23
Postoperative positive inotrope need	1 (10%)
Intensive care unit duration (days) [median (25-75 percentile)]	2 (1.75-7)
Hospital stay duration (days) [median (25-75 percentile)]	9.5 (7-17.5)
Follow-up duration (months) [median (25-75 percentile)]	45.57 (9.69-58.25)
Recurrence	0
In-hospital mortality	2 (20%)
Long-term mortality	2 (20%)

Table 3. Related cardiac structure, localization and histopathologic diagnosis of the excised cardiac masses

Related cardiac structure	Localization	n (%)	Pathological identification
Left atrium	Interatrial septum	4 (40)	Myxoma
	Posterior wall	1 (10)	Myxoma
	Posterolateral wall	1 (10)	Thrombus
Right atrium	Lateral wall	2 (20)	Thrombus
Mitral valve	Posterior annulus	2 (20)	Chronic inflammation

histopathologic diagnosis was atrial myxoma (n=5, 50%), followed by thrombus (n=3, 30%) and chronic inflammation (n=2, 20%). Eight (80%) patients had left sided intracardiac mass while 2 (20%) had right-sided.

Discussion

Cardiac masses consist of primary and secondary tumors, as well as thrombotic, infectious, cystic, and congenital pathologies (1). Primary cardiac tumors are uncommon, with 10% of them being malignant and 90% of them benign, according to data from autopsy series. Myxomas account for the vast majority of benign tumors and are most typically located in the left atrium (2,3). Consistent with previous research, the majority of primary intracardiac masses in our study were atrial myxomas. Left atrial septum was the most common location among the five patients diagnosed with atrial myxomas. In fact, thrombi are the most prevalent intracardiac masses, appearing in the atria and ventricles of patients with cardiovascular pathologies or hypercoagulable conditions as malignancy and intracardiac catheters (2). Systolic dysfunction usually with aneurysm formation, is the most common cause of thrombus of left ventricle in patients with ischemic heart disease and dilated cardiomyopathy. The right atrium and left ventricle were the most common locations for thrombi, whereas the left atrium had the fewest. We excluded patients in whom thrombus was definitively diagnosed prior to surgery. However, in our patient group, three patients who underwent surgery with a preliminary diagnosis of primary cardiac mass were unexpectedly diagnosed with thrombus on histopathologic examination. Thrombus is the first entity that comes to mind when considering a differential diagnosis for cardiac masses. Consequently, while non-invasive techniques such as echocardiography and MRI are advantageous in determining the key features of the cardiac mass, such as location and tissue characteristics, definite identification requires surgery and biopsy. Just after a cardiac mass is diagnosed, immediate surgical intervention is the best course of action. In the period between diagnosis and surgical intervention, mortality may occur due massive embolization or obstruction, according to the literature (6). In our series, the mean duration between diagnosis and surgical intervention was 1.7 days, ranging from 1 to 3 days.

Cardiac myxomas are most common in women in the fourth and sixth decades of life (7), a finding consistent with our patient series.

In patients with cardiac mass, the typical triad of obstructive cardiac sign, embolic event, and constitutional manifestation determines the symptoms and presentation. Cardiac mass symptoms are generally non-specific, with dyspnea being the most commonly reported sign in patients (5). The presenting symptoms of patients with cardiac masses in our study were dyspnea in six (60%), angina in two (20%), palpitation in one (10%), and stroke in two (20%), similar to the literature. Due to their intracardiac location and fragile nature, cardiac masses might be an embolism source. Myxomas, particularly those found in the left cavities of the heart, have the potential to embolize into the circulation and cause infarction and ischemic symptoms by moving to the cerebral, renal, femoral, coronary, and other visceral arteries (8). Systemic embolism has been documented in the literature in 30 to 45 percent of left atrial myxoma patients. Stroke was the first finding in 2 (20%) of our patients, leading to the diagnosis of cardiac mass.

As a first step in the diagnostic process, cardiac mass should be suspected in patients with persistent dyspnea, a history of systemic embolization, an acute neurological disorder, and a family history of cardiac mass, even though approximately 3.2 to 46.4 percent of patients with cardiac mass are asymptomatic (9). In this patient population, TTE should be considered as a primary diagnostic method. With a sensitivity of 95%, TTE is the most effective initial modality for the diagnosis of myxoma, whereas TEE has a sensitivity of 100% (10). However, to differentiate between a primary cardiac tumor and other cardiac masses, echocardiography is not very accurate. Especially, cardiac myxoma is frequently misdiagnosed with atrial thrombus. For a thorough assessment of cardiac masses, MRI and CT have proven to be an effective technique. These imaging techniques are non-invasive, provide a wide field of view, and enable direct multiplanar imaging. Although echocardiography was used to diagnose all of the patients in our study, MRI was also used in three (30%) of them. Although we thoroughly evaluated the patients prior to surgery by integrating clinical findings and imaging modalities such as TTE, TEE, and MR, the pathological diagnosis in 3 patients was thrombus and in 2 patients it was

chronic inflammation. Especially, the pathological diagnosis of thrombus was unexpected to us, even though the excised cardiac mass in one of our patients was preoperatively thought to be a myxoma due to contrast enhancement on MRI. In addition to imaging techniques, the patient's age, gender, symptoms, and underlying comorbid disorders must be taken into account when evaluating intracardiac masses.

Depending on where the tumor is located, various approaches have been presented in the literature. Left and/or right atriotomy, biatrial and transseptal approaches are commonly the most favoured techniques (11). Key things to consider while selecting the surgical approach to the mass include minimal manipulation of the mass, adequate exploration for resection, and the possibility to entirely remove the mass. We decided our surgical strategy based on the location of the cardiac mass: we performed right atriotomy for right atrial masses and left atriotomy for left atrial masses. With this method, none of our patients experienced complications such as postoperative systemic embolism, arrhythmia, or evidence of inadequate excision in the follow-up period. The advantages of the biatrial method were stated by Jones et al. (11) as direct visibility, little manipulation, appropriate excision, and evaluation of all heart chambers. However, there have been concerns that the high rate of arrhythmias and conduction disturbances following tumor removal may outweigh the benefits of this strategy.

Bahnson and Newman (12) completed the first successful removal of an intracardiac mass with inflow occlusion technique around 400 years after Realdo Colombo described the first cardiac tumor (13). In the years that followed, in 1954, Professor Crafoord successfully excised the left atrial myxoma for the first time by the use of extracorporeal circulation (13). In recent years, minimally invasive procedures have been adopted widely in the field of heart surgery. According to a comparative study by Kadiroğulları et al. (14) robotic-assisted endoscopic surgery for cardiac myxoma excision has been shown to be safe and effective, with benefits including a shorter hospital stay, reduced pain, and less blood product consumption, along with better cosmetic outcomes than conventional median sternotomy. However, concerns have been raised regarding the application of this technique to cardiac mass resection due to the increased manipulation of the mass, which increases the risk of local and systemic embolization, and the limited use for concomitant procedures.

The retrospective design with a small sample size is the major limitation of our study. However, the lack of a control group and the inability to make comparisons are other limitations of the study. It is important to point out that this is because cardiac masses are relatively uncommon.

Conclusion

The cardiac masses can present with a wide variety of clinical manifestations, and when indicated, successful surgical resection can be performed with minimal morbidity and mortality with the assistance of preoperative sophisticated imaging modalities and detailed clinical evaluation.

Ethics

Ethics Committee Approval: The study protocol was approved by the Local Ethics Committee of the Selçuk University Medical Faculty (approval number: 2022/267 and approval date: 24.05.2022).

Informed Consent: Each patient signed a written informed consent form.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: Ö.F.Ç., M.B., A.O., H.A., Concept: Ö.F.Ç., M.B., Design: Ö.F.Ç., A.O., Data Collection or Processing: Ö.F.Ç., İ.E.Ö., A.T., Analysis or Interpretation: Ö.F.Ç., H.A., Literature Search: Ö.F.Ç., İ.E.Ö., Writing: Ö.F.Ç., A.T.

Conflict of Interest: No conflict of interest was declared by the authors.

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