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Cardiac myxomas: an analysis of 39 patients

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ABSTRACT

Objectives. Myxomas are the most common benign primary heart tumors. They have serious complications including intracardiac blood flow obstruction and embolic events. The aim of the study was to assess our experiences related to patients undergoing surgical resection for cardiac myxomas. ***Methods.*** The medical records of 39 patients, aged 16 to 76 years (mean, 47.5 years), who were operated on for primary cardiac myxomas between January 1994 and December 2016 at our clinic were retrospectively evaluated. Demographic, clinical, operative and postoperative data were obtained from these hospital medical records. Cardiac myxomas were diagnosed by transthoracic echocardiography. Preoperative coronary angiography was performed in patients over 40 years of age and those with symptoms of coronary disease. In routine follow-up after discharge the patients were checked by echocardiography. Long-term cumulative survival was analyzed using the Kaplan-Meier method. ***Results.*** There was no in-hospital mortality. The majority (61.5%) of patients were female. The most common encountered localization of myxoma was the left atrium (76.9%), and the classic posterior approach from interatrial groove was preferred in 32 (82.1%) patients. Mean follow-up was 6.05 ± 3.75 years (range, 1-10 years). Five (12.8%) patients were lost on long-term follow-up. Kaplan-Meier curves, cumulative proportion surviving of patients at 1-, 2-, 5-, and 10-year were 97.4%, 91.7%, 84.7%, and 84.7%, respectively. No hospital mortality was observed in any of the patients. There was no recurrence in our series. ***Conclusions.*** Myxoma is the disease that can lead to complications such as embolic events and intracardiac blood flow obstruction. It can be excised with a low rate of morbidity and mortality. Surgical resection should be performed promptly after diagnosis in order to prevent potential complications.

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Keywords: Cardiac tumors, myxomas, cardiac surgery, echocardiography

Introduction

Myxomas are the most common seen primary benign heart tumors. Although they can be found in all chambers of the heart, 75% of cases is localized in the left atrium [1, 2]. Despite their benign nature, they have serious complications including intracardiac blood flow obstruction and embolic events [3]. If left untreated, they are unappeasable progressive and result in fatal outcomes.

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The most effective treatment of myxomas is surgical removal. Many surgeons agree that the surgical excision of the tumor should be performed promptly after diagnosis in order to avoid potential serious complications. Surgical resection of the myxoma has good results. However, patients should be followed-up closely after surgery because recurrent myxomas may occur, requiring reoperation [4].

The aim of the study was to evaluate our experiences related to patients undergoing surgical resection for cardiac myxomas and to review the literature.

Methods

Patients

Thirty-nine patients undergoing surgical resection for primary cardiac myxomas between January 1994 and December 2016 at our institution were retrospectively evaluated. Demographic, clinical, operative and postoperative data were obtained from hospital records. All medical records including echocardiography (transthoracic and/or transesophageal), electrocardiography, exercise tests, coronary angiography, surgical, pathological and postoperative reports were analysed. Twenty-four (61.5%) of the patients were female, 15 (38.5%) were Male. The mean age was 47.5 ± 13.12 years and ranged in age from 16 to 76 years. Myxoma was diagnosed primarily by transthoracic two-dimensional echocardiography, in only one patient diagnosis made by echocardiography performed after abnormal coronary artery vascularization detected during coronary angiography. Cardiac myxoma diagnosed by transthoracic echocardiography was confirmed by transesophageal echocardiography. Preoperative coronary angiography was performed in patients over 40 years of age or in cases of anginal symptoms. This study was approved by the Local Institutional Ethics Committee and and a waiver of informed consent was obtained.

Surgical Technique

Median sternotomy was performed in all cases. Routine cardiopulmonary bypass was instituted with aortic and bicaval cannulation and cardiac arrest was provided using antegrade cardioplegia. Myocardial protection was achieved firstly by antegrade cold crystalloid 'St Thomas' cardioplegia, subsequently, intermittent blood cardioplegia. and surgical procedures were performed under aortic cross-clamp. Surgical approach was performed according to the localization of the myxoma and radical excision with the attachment base of mass was performed. Where necessary, septal defects caused by myxoma excision were repaired with a patch of autologous pericardium and after the operation all excised tumor materials were sent for routine histopathological examination (Figure 1A and 1B). Cardiac chambers were irrigated with saline to prevent possible microembolisms after excision. If applicable, additional concomitant surgical procedures were performed for cardiac pathologies accompanied by myxomas. In routine follow-up after

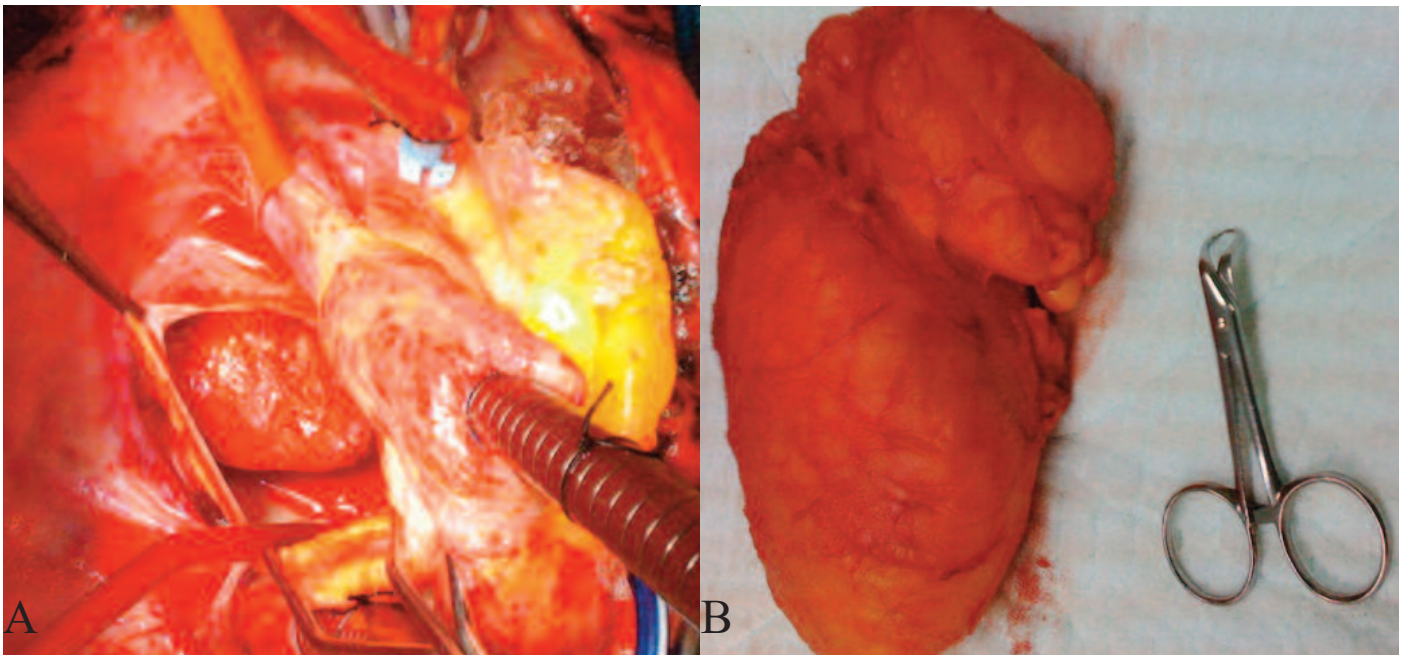

Figure 1. Intraoperative appearance of the myxoma (A) and excised myxoma (B).

discharge, patients were checked by echocardiography.

Statistical Analysis

Data are expressed as mean ± standard deviation (SD) for all continuous variables or as minimum and maximum values if there is not normal distribution or as numbers with percentages for complication and recurrence rates, including information about preoperative status where appropriate. Long-term cumulative survival was analyzed using the Kaplan-Meier method. Statistical analysis data were analyzed with the Statistical Package for the Social Sciences (IBM SPSS Statistic Inc. Version 21.0, Chicago, IL, USA).

Results

The preoperative clinical status and age distribution of the patients are shown in Table 1. The majority (61.5%) of patients were female and patients were found most frequently in the age range of 40-60 years. Thirty (76.9%) of the detected myxomas were originated from the left atrium and in half of them left atrial trombus was found. Peripheral arterial thromboembolism was the cause of admission to the hospital in 6 (15.4%) of the patients. Preoperative coronary angiography performed in 20 (51.3%) patients and 9 (23.1%) of these patients underwent coronary artery bypass grafting with tumor excision. Surgical procedures applied to the patients are shown in Table 2. Histopatologic study of the mass confirmed the diagnosis of myxoma.

In 32 (76.9%) patients with myxoma originated from the left atrium, posterior mitral valve myxoma and biatrial and biventricular recurrent myxoma, posterior approach was applied from interatrial grove. The septum was repaired with a pericardial patch after excision in 6 of the myxomas arising from the left atrial septum. Mitral valve replacement was performed in 3 (7.7%) patients with concomitant mitral stenosis and in one (2.6%) patient with myxoma arised from posterior mitral leaflet. In addition to tumor resection, mitral valve annuloplasty was performed in the 5 (12.8%) patients with mitral regurgitation. Right

Table 1. Demographic and clinical characteristics of the patients

	n (%)
Age (years)	47.15 ± 13.2 (16-76)
Gender, female	24 (61.5)
Localization	
Left atrial septum	21 (53.8)
Left atrial wall	9 (23.1)
Mitral valve posterior leaflet	1 (2.6)
Right atrial septum	7 (17.9)
Biatrial + biventricular (multiple)*	1 (2.6)
Symptoms	
Dyspne	26 (66.7)
Palpitation	19 (48.7)
Angina	3 (7.7)
Syncope	2 (5.1)
Heart failure	3 (7.7)
Acute pulmonary edema	1 (2.6)
Peripheral thromboembolism	6 (15.4)
Co-morbidity	
Coronary artery disease	9 (23.1)
Dilate cardiomyopathy	1 (2.6)
Left atrial thrombus	17 (43.6)
Tricuspid valve regurtation	4 (10.3)
Mitral valve stenosis	6 (15.4)
Mitral valve regurtation	4 (10.3)
Atrial fibrillation	8 (20.5)

Data are shown as mean ± standard deviation (range) or number (percent). *Patient who had underwent myxoma surgery at another center 8 years ago

Table 2. Surgical procedure

Procedure	n (%)
Resection	17 (43.6)
Resection+CABG	9 (23.1)
Resection+MVR	4 (10.2)
Resection+MR	4 (10.2)
Resection+TR	4 (10.2)
Resection+MR+TR	1 (2.6)

Data are shown as number (percent). CABG = coronary artery bypass grafting, MR = mitral repair, MVR = mitral valve replacement, TR = tricuspid repair

atriotomy was performed in 8 (20.5%) patients with right atrial myxoma, and biatrial and biventricular recurrent myxoma. Due to the large resection of the interatrial septum in 2 (5.1%) patients, the septum was repaired with pericardial patch while primary repair was sufficient in 6 (15.4%) patients. In 5 (12.8%) patients with concomitant moderate or severe tricuspid regurgitation, De Vega tricuspid annuloplasty was performed.

As a remarkable event, in one patient, a mass found incidentally in the left atrium was excised during mitral valve surgery. After pathological examination the diagnosis of the mass was confirmed as myxoma.

In echocardiographic examination of another case with acute cardiac insufficiency findings who had episodes of syncope and pulmonary edema, a pedicled myxoma was found in the left atrium. It was observed that the mass was prolapsed to the left ventricle during each diastole and returned to the left atrium during systole. The patient had arrhythmia and low cardiac output due to intermittent obliteration of the mitral valve orifice by the mass. The case underwent to emergency operation.

Another patient with dilated cardiomyopathy, whose ejection fraction was measured as 18%, was operated electively for hemodynamic instability and syncope episodes because of occlusion at the mitral valve orifice. The myxoma was successfully removed under a very short cross-clamp time.

Biatrial and biventricular recurrent myxomas were detected in echocardiography performed due to the shortness of breath in one (2.6%) patient who underwent resection for left atrial and right ventricular myxoma at another center 8 years ago [4]. Atrial and ventricular myxomas were successfully excised by performing biatrial incision. At the same time, mitral and tricuspid valve repair was performed.

In a patient admitted to our hospital with symptoms of stable angina pectoris, coronary angiography was performed after a positive evaluation of the effort test. While coronary arteries were found normal on coronary angiogram, a large mass revealed which has very advanced vascularity and feeding from the circumflex and the right coronary artery. Echocardiography revealed a myxoma in the left atrium and anginal symptoms disappeared after removal of the myxoma.

No hospital mortality was observed in any of the patients. The postoperative course was uneventful and follow-up examination showed normal doppler echocardiographic parameters and clinical recovery. Mean follow-up was 6.05 ± 3.75 years (range, 1-10 years). Five (12.8%) patients were lost on long-term follow-up. There were three deaths due to traffic accident in one case and cardiac reasons related to coronary artery disease in 2 cases. Two patients could not be reached because of the remote rural area. Kaplan-Meier curves, cumulative proportion surviving of patients at 1-, 2-, 5-, and 10-year were 97.4%, 91.7%, 84.7%, and 84.7%, respectively (Figure 2).

Discussion

The primary cardiac tumors are benign at the rate of 75% and myxomas are the most common encountered tumors. Fibroelastoma, hemangioma and fibroma are the other types of cardiac benign tumors [3]. Most common malign primary cardiac tumor is angiosarcoma and metastatic tumors frequently originate from lung and breast carcinomas. Myxomas are thought to develop from primitive endothelial or subendocardial cells, or from multipotential mesenchymal cells [5].

Myxomas can occur in all chambers of heart and 75% of myxomas located in the left atrium [1]. The majority of the myxomas detected in our study were of left atrial origin. Clinical symptoms are usually seen in adults, and most often between the third and sixth

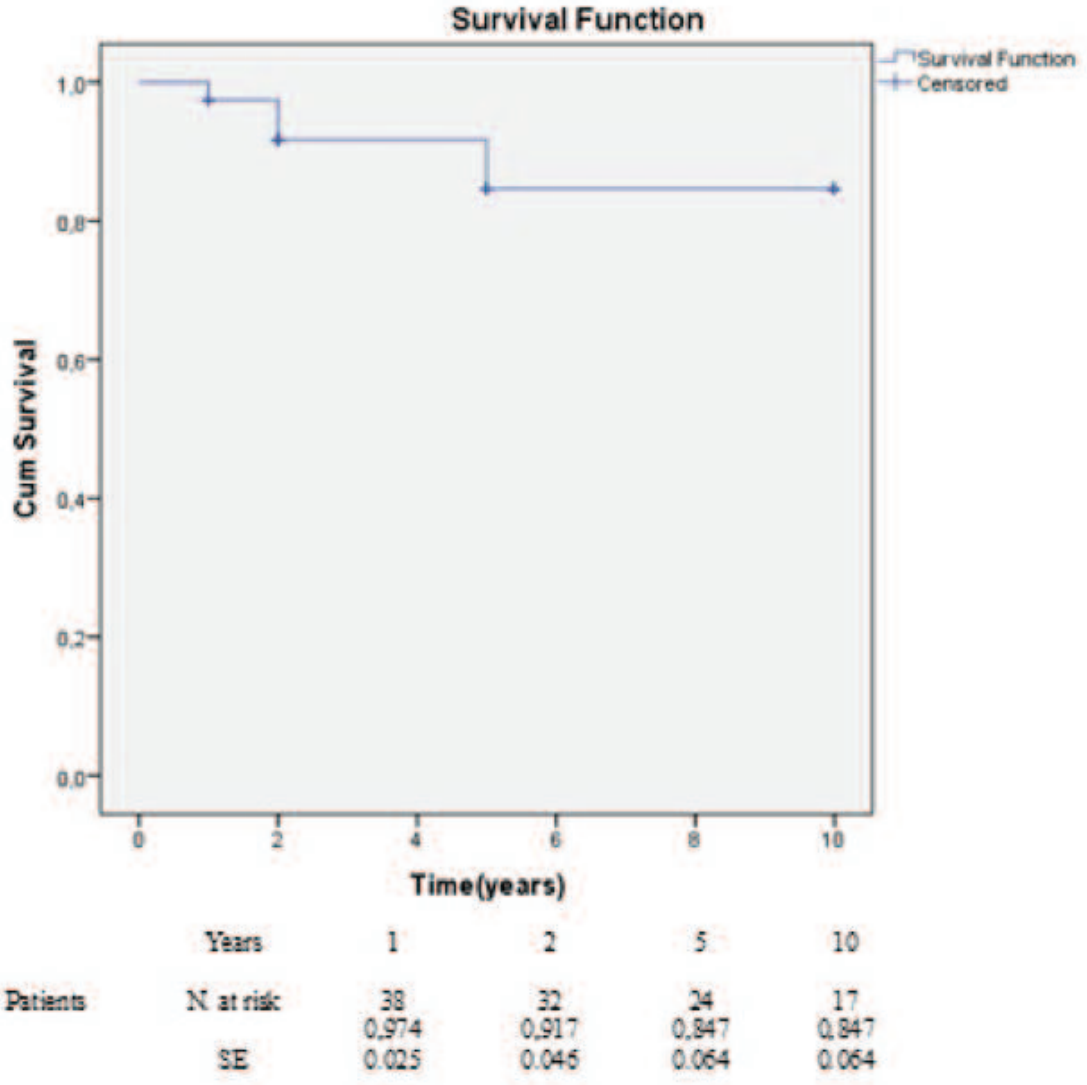

Figure 2. Long-term cumulative survival curves (Kaplan-Meier) after surgery. The proportion of patients following 1 year was estimated as 0.97 ± 0.025, 2 years as 0.91 ± 0.046, 5 years and 10 years as 0.84 ± 0.064. SE = standart error.).

decades and women are more frequently affected. Our patient's average age was 47.15 and female-male ratio was 1.6.

Most of myxomas are idiopathic. However 5% of cases have familial history. Familial form generally is known as Carney's syndrome. This syndrome has an autosomal dominant transition and frequently seen in younger males. Mucosal myxoma, skin hyperpigmentation and endocrine organ hyperactivity accompanies to this syndrome [3].

The clinical presentation of cardiac myxomas are classified in three main categories: tumor-related obstruction of intracardiac blood flow, tumor-related embolic events, and systemic symptoms [3]. Clinical features are related with size, location and mobility of the myxoma. Meşe *et al.* [6] reported a case with a giant left atrial myxoma that completely obstructed the left atrioventricular flow leading to acute pulmonary edema. We had a case that underwent operation urgently with similar symptoms in our series. As stated in the literature, the most common symptoms in our series with cardiac myxomas were also congestive heart failure, dyspnea and palpitation [3, 5, 7, 8]. In particular, tumors originating from the septum exhibit symptoms of congestive heart failure, whereas those that do not originate from the septum are more associated with embolic events [9].

Embolic events may be the first sign of cardiac myxomas. Many embolic events such as cerebral embolism, lower extremity embolisms, visceral organs and coronary embolism may be resulted from an intracardiac myxoma [3]. Papillary and fragmented myxomas with irregular surface are more prone to embolism than solid ones. Coating by thrombus of

irregular surface of papillary tumor contributes to embolism process. In two studies comparing papillary and solid myxomas, embolism predisposition was found more to favor papillary myxoma [10, 11]. Taş et al. [8] detected the embolic events of 25% in their study and reported that 75% of them were cerebral. Kaplan *et al.* [7] reported that they identify cerebral embolism of 2% versus peripheral embolism of 11%. In our study we detected embolism of 15.4% and all of them were peripheral events. It should also be kept in mind that the right-side myxomas may lead to pulmonary embolism but uncommon, while the left side ones can rarely cause pulmonary embolism in the presence of atrial septal defect and ventricular septal defect [12]. In a retrospective analysis, He *et al.* [13] reported that location and size of the tumor, macroscopic appearance, mean platelet volume, and high platelet count are closely associated with embolic events in patients with cardiac myxomas.

Echocardiography is the most important diagnostic method for diagnosis of the cardiac myxomas. It can give an accurate information about the size, localization and origin of the tumor. In our clinic, myxomas was diagnosed by two-dimensional transthoracic echocardiography and transesophageal echocardiography have been used to confirm the diagnosis of myxoma. Likewise, postoperative echocardiography shall be sufficient for control. Other imaging modalities that are equally useful for diagnosis but are not easily accessible, and are generally more costly and time-consuming, are thoracic CT and MRI, on which myxomas appear as spherical or ovoid intracavitary masses of heterogeneous composition [14].

Treatment of cardiac myxomas is surgery. Surgical treatment should be performed as soon as the diagnosis is made. Surgical approaches vary according to myxomas origin. Different techniques such as posterior approach from interatrial groove, transseptal approach, biatrial approach, T-shaped biatrial approach, and superficial septal approach are available for myxoma excision [6]. No matter which surgical technique, it is necessary to avoid unnecessary manipulations until the tumor is excised to prevent the intraoperative embolism. The surgical approaches should provide adequate exposure for a complete resection, and allow for the inspection of all four heart chambers in order to minimize the risk of recurrence. In addition, right atrium myxomas can be injured during cannulation. In surgical manipulation this issue should not be overlooked.

The classic posterior approach from interatrial groove may be suitable in most cases especially for thin pedicled myxomas and the defect can be closed primarily. However, in order to reduce the recurrence rate, a large resection of the septum and a patch for its closure may be required. Taş *et al.* [8] reported that about half of the cases were operated with classical left atrial approach in their study. In our series classical left atrial incision were used for myxomas which originated from the left atrium and only in three cases pericardial patch was used for repair of the defect due to wide septum resection. The transseptal approach is performed through right atriotomy. Kaplan *et al.* [7] described that the transseptal approach is well suited for clear exploration, comfortable resection and keeping under control of all cardiac chamber. The transseptal approach gives good access to the myxoma with minimum handling and allows inspection of all cardiac chambers [15]. The biatrial approach of left atrial myxomas is considered more appropriate in the literature [1]. The biatrial approach includes both a vertical incision made in the posterior of the interatrial groove and a transverse incision on the right atrium. In our study we could be able to resect easily the myxomas by biatrial approach in a case which we found recurrence in four cardiac chamber. Meşe et al. [6] reported that they excised a giant left atrial myxoma by performing superior septal approach. The right atrium and the right ventricule myxomas are approached through the right atrium.

Recurrence may occur after surgical resection of myxomas. Inadequate resection, being familial type, intraoperative implantation and embolization of tumor fragment are among the causes of recurrence [3, 4]. Garatti *et al.* [10] reported a recurrence rate of 1% in the series of large resection and patch use, whereas McCarty *et al.* [16] reported that this rate was as high as 10-30% in familial cases. There was no recurrence in our series, however we determined a case with multiple localized recurrent myxoma 8 years after surgery for left atrial and right ventricular myxoma in another center [4]. It should be noted that appropriate approach according to localization, wide resection and checking the other cardiac chambers may decrease reccurence rate. Normally echocardiographic follow-up should be performed each year to detect early myxoma relapses.

Cardiac myxomas may exist with concomitant cardiac disease. Injury of mitral subvalvular apparatus or leaflets can cause mitral regurgitation [5, 17]. Gucu *et al.* [18] presented a case of myxoma that was

located in the mitral valve with mitral insufficiency and accompanying intracranial tumor. In our series, mitral valve repair or replacement was applied at rate of 25%.

In the literature, the incidence of coronary artery disease is reported to be between 20% and 36% in patients with myxoma due to age and atherosclerosis. Furthermore, the likelihood of causing coronary artery embolism of myxoma is reported as 0.06% [19, 20]. Consistent with the literature, we performed coronary artery bypass grafting in addition to myxoma resection in 23.1% of our patients. Because of this high association, preoperative coronary angiography for patients with symptoms and over 40 years is necessary.

Conclusion

As a result, despite being benign, cardiac myxomas are pathologies that can lead to complications such as embolic events and intracardiac blood flow obstruction. It can be excised with a low rate of morbidity and mortality. Surgical resection should be performed promptly after diagnosis in order to prevent potential complications and even possible fatal outcomes.

Authorship declaration

All authors listed meet the authorship criteria according to the latest guidelines of the International Committee of Medical Journal Editors, and all authors are in agreement with the manuscript.

Conflict of interest

The authors disclosed no conflict of interest during the preparation or publication of this manuscript.

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