Cardiac rhabdomyomas in childhood: six cases from a single institution

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Primary cardiac tumors are rare during childhood. The most frequently encountered tumors are rhabdomyomas. We reviewed the clinical characteristics, treatment results, and outcomes of six pediatric patients with primary cardiac rhabdomyomas. The mean age was 16.8 days. Only one patient was symptomatic. The tumors mostly originated from the left ventricle. The diagnosis was established by magnetic resonance imaging (MRI) plus echocardiography with or without histopathology. Total tumor resection was performed in two patients. After a median follow-up of 39 months, one patient had a stable tumor, two patients had marked tumor regression and one had complete tumor regression. Considering the fact that rhabdomyomas often show spontaneous regression, close follow-up may be sufficient in hemodynamically stable cases. Although rhabdomyomas do not cause any symptoms at the time of diagnosis, they may lead to sudden death; thus, further studies may be required for the decision of surgery and/or follow-up. The localization and infiltrative characteristics of the tumor are critical factors for decision-making in children with symptomatic rhabdomyoma even if surgery is indicated in such cases.

Key words: cardiac, rhabdomyoma, children, heart, tumor.

Primary cardiac tumors are rare during childhood, and frequently are congenital and benign[1,2]. The most frequently encountered congenital tumors are rhabdomyomas, while myxomas and fibromas are observed in older children[2]. After rhabdomyomas, the most common cardiac tumors in children are teratomas, fibromas and hemangiomas[3-6]. In autopsy series, the prevalence of primary cardiac tumors has been reported to range from 0.0017 to 0.28[6,7].

Most patients with primary cardiac tumors are diagnosed by echocardiography performed during the perinatal period; the complaints and findings include arrhythmia, murmur, respiratory distress, and cyanosis[2,7]. The affected cardiac conduction system and intracardiac blood flow obstruction are mainly responsible for the occurrence of these symptoms[3]. The tumors are generally multifocal, homogeneous and well-defined masses of varying size; these tumors are predominantly located in the left ventricular wall, ventricular septum and atrial wall[3,4,8]. Multifocal tumors are associated with tuberous sclerosis in 78% to 95% of the cases[3,4]. Spontaneous regression occurs during the first 2-4 years in 33% of the cases[1]. The most important complications of cardiac tumors are arrhythmia, systolic and diastolic dysfunctions, Wolff-Parkinson-White syndrome, thromboembolism, and ventricular outflow obstruction[9,10].

This study aimed to present the clinical features and outcomes of six patients with cardiac rhabdomyomas diagnosed and followed up in a single institution.

Material and Methods

We conducted a retrospective review of the medical records of six patients who were ≤16 years of age, diagnosed with primary cardiac

tumors, who were treated at our center between January 2002 and January 2012.

Demographic characteristics and physical findings on admission were recorded. The findings of radiological examinations such as chest radiography, computed tomography (CT), magnetic resonance imaging (MRI), and echocardiography (ECHO) were evaluated. All surgical interventions and associated complications and long-term follow-up results of the patients were recorded.

Results

Six (0.3%) of 2200 children with pediatric tumors were diagnosed with primary cardiac rhabdomyomas at our center between 2002 and 2012. The mean age of the cases was 16.8±10 days (median: 20 days; range: 1-30); the female to male ratio was 4:2. Clinical characteristics, treatment results and outcomes of these six patients are summarized in Table I.

Only one patient had complaints at presentation. One of the cases was diagnosed incidentally by prenatal ultrasonography. The tumors mostly originated from the left ventricle (Table I). The tumor was multifocal in one patient. One patient (Case 5) had a right ventricular mass extending to the right atrium. Another patient (Case 4) with a left ventricular mass had cardiac blood flow obstruction, and ECHO showed that the mass extended to the left atrium. While chest radiographs were normal in four patients, cardiomegaly was observed in two patients. Diagnostic studies are presented in Table I, and the diagnosis was established by MRI plus ECHO with or without histopathology. One patient (Case 3) also had a massive pericardial effusion. Another patient (Case 4) had tuberous sclerosis and epilepsy.

Clinically important arrhythmias were present in two patients (Case 1 and Case 6). Case 1 had ventricular tachycardia (VT) and Case 6 had bradycardia. Both arrhythmias were due to tumor infiltration. VT was treated with antiarrhythmic medications. Transesophageal electrophysiological study was done for the evaluation of bradycardia. An emergent total tumor resection was performed due to persistence of bradycardia. However, bradycardia was not corrected after surgery,

Table I. Clinical Characteristics, Treatments, and Outcomes of the Patients with Cardiac Rhabdomyomas

Case	Age (days)/ Sex	Symptoms	Site	Methods of diagnosis	Surgery	Follow-up (month)/ Outcome
1	1/F	Arrhythmia	Left and right ventricle (multifocal)	ECHO + MRI	NP	126/Alive
2	10/M	Dyspnea, central cyanosis, groaning	Left ventricle	ECHO + CT + Histopathology	Biopsy	89/Alive
3	30/M	Prenatal ultrason ography	Left ventricle	ECHO + MRI	NP	22/Alive
4	20/F	Murmur	Left ventricle	ECHO + MRI + Histopathology	Total tumor resection	39/Alive
5	20/F	Murmur	Right ventricle	ECHO + MRI	NP	4/Died*
6	20/F	Bradycardia	Right ventricle	ECHO + MRI + Histopathology	Total tumor resection	Died after operation

F: Female. M: Male. NP: Not performed. ECHO: Echocardiography. MRI: Magnetic resonance imaging. CT: Computed tomography. *: Sudden death at home after discharge.

and a dual chamber pacemaker was inserted. The patient died due to cardiac insufficiency after the operation.

Diagnosis of rhabdomyoma was established by open biopsy in three patients. The other three patients were diagnosed by clinical and radiological findings. All of the cases were diagnosed during the last 10 years. Total tumor resection was performed by open heart surgery in two patients. One is still alive after 39 months (Case 4), while the other (Case 6) died during the postoperative period due to bradycardia. One patient (Case 2) underwent only biopsy due to the diffuse infiltration of the myocardium by the mass. This patient was under follow-up for 89 months. Two of three patients who were diagnosed clinically and radiologically (Cases 1 and 3) survived, while Case 5 died at home after discharge. Survivals and outcomes are presented in Table I. After a median follow-up of 39 months (range: 4-126 months), one patient had a stable tumor, two patients had marked tumor regression and one patient had complete tumor regression.

Discussion

Primary cardiac tumors are rare in childhood and are often benign[1]. The prevalence of cardiac tumors has been reported to be less than 0.32% in all ages[4]. Only 10% of the cases in children display a malignant character[6]. Rhabdomyomas are the most common cardiac tumors in childhood and comprise 45-75% of the cases[9]. Identification of only six cases in a 10-year period at our center highlights the rarity of these tumors in children. As a major reference center, the cases with cardiac rhabdomyomas constituted 0.3% of the total 2200 childhood cancer cases. The rate of cases with cardiac rhabdomyomas found in the present study was in parallel with those reported in the literature. On the other hand, the fact that all of our cases were diagnosed after the year 2000 may be associated with the use of modern prenatal and postnatal imaging techniques as well as the lack of referral to oncology centers.

Most of the cases with cardiac rhabdomyomas are asymptomatic, and they may present with arrhythmias, murmurs, convulsions as a finding of tuberous sclerosis, findings of intracardiac blood flow obstruction, or problems associated with the respiratory system[3,11-14]. Murmurs and arrhythmias were found in most of our patients, and the mass was diagnosed by prenatal ultrasonography in one child.

Echocardiography, CT and MRI are noninvasive methods to diagnose cardiac tumors[5]. Chest radiography is only helpful to show cardiomegaly, and electrocardiography is critical to show the presence of arrhythmias. In our study, tumors were confirmed by ECHO and MRI in five patients and by ECHO and CT in one patient. MRI is preferred since there is no risk of radiation and the mass can be better visualized. We consider that the combined use of ECHO and MRI will highly suggest the diagnosis of cardiac rhabdomyomas. The diagnosis was confirmed histopathologically in three children operated due to the symptoms caused by the mass. The fact that chest radiographs showed cardiomegaly in two patients but were normal in the other cases suggests that ECHO or cardiac MRI should be performed in symptomatic cases, even if a chest radiograph appears normal in these patients.

It was reported in the literature that 21%[15], 24%[11], 33%[12], 36%[16], 46%[14], and 55%[2] of the cases with cardiac rhabdomyoma were diagnosed by prenatal ultrasonography. These ratios reported in the literature have shown a gradual increase in recent years; this may be due to the technological developments and increased experience in prenatal ultrasonography. Considering that the median age was 20 days in the present study, all were congenital cases; however, only one patient was diagnosed by prenatal ultrasonography. This may suggest that there could be a lack of knowledge and awareness in prenatal diagnosis; however, one must also note that the number of the cases was low in the present study.

Approximately half of rhabdomyomas have been reported to be associated with tuberous sclerosis[2,15]. One case in our study was associated with tuberous sclerosis. Unlike the rhabdomyomas observed in tuberous sclerosis, the tumor was a solitary lesion in this child. This low ratio may have resulted from the small sample size of the present study. In the literature, the primary tumor has been reported to be of ventricular origin[2], and the tumors in all cases of our study were of ventricular origin, mostly in the left. Another finding in

parallel with the literature was the spontaneous regression of rhabdomyomas[12,14,15]. In the follow-up period, complete regression was observed in one of our patients, while two patients showed tumor regression of more than 50%; the tumor remained stable in one patient.

One patient died suddenly on the 4th day after discharge. She presented with a murmur, and a right ventricular mass was identified. Follow-up is advised since there is no hemodynamic dysfunction. In the literature, as well as in our center, surgery is not usually recommended in patients with normal hemodynamics due to the possibility of spontaneous regression of rhabdomyomas[1,3,5,8,9]. However, the case presented herein indicates that a decision for surgery should be taken cautiously. In the literature, a similar case was reported, who was admitted with syncope, diagnosed to have cardiac rhabdomyoma and died during the preparations for surgery[17]. Moreover, Cina et al.[18] reported that of the 103 primary benign cardiac tumors that caused sudden death, 9 (8.7%) were rhabdomyomas.

Case 2 in the present study was important from a radiological point of view. This patient was admitted with findings of cardiac insufficiency; a left ventricular mass was identified. However, during the operation, it was found that the mass had diffuse infiltrative characteristics; thus, a biopsy was performed and the operation was ended. The patient is still alive with no complications. In this patient, cardiac insufficiency most probably resulted from the decreases in the contractility and compliance of the left ventricle due to the infiltration of the left ventricle by the mass. Surgery was also decided for this patient; however, resection was impossible because of the characteristics of the mass. Though rhabdomyomas are benign tumors, they may pose a risk due to their localization in the heart and their infiltrative characteristics. Therefore, close follow-up of these tumors, which are also considered hamartomatous lesions[17], during the regression process is of importance.

Another important point is that some tumors may cause malignant arrhythmias leading to sudden cardiac death[19,20]. Miyake et al.[20] reported that 16% (17/106) of primary cardiac rhabdomyomas caused significant arrhythmias. They also reported that 24% of all 173 primary cardiac tumors were associated with significant arrhythmias. Surgical resection and/or antiarrhythmic medication is the main treatment strategy for these patients. In the present study, one patient died due to bradycardia, and the other was treated with short-term use of antiarrhythmic drugs.

Although the main treatment for cardiac tumors is surgical resection, suitability of the patients for general anesthesia, their hemodynamic status and postoperative intensive care conditions are of utmost importance. In addition, the quality of the care during the first months may affect the prognosis of the disease, since these tumors show spontaneous regression in approximately 50% of the cases[13].

In this study, none of our patients experienced any complications such as arrhythmia, thromboembolism, or ventricular dysfunction during the follow-up.

In conclusion, primary cardiac tumors in childhood are rare, and rhabdomyoma is the most common. Considering the fact that rhabdomyomas often show spontaneous regression, close follow-up is sufficient in hemodynamically stable cases. Although rhabdomyomas do not cause any symptoms at the time of diagnosis, they may lead to sudden death; thus, a good clinical evaluation is critical for the decision of surgery and/or follow-up. Another important issue is that suitability for surgical operation should be assessed in detail in some symptomatic rhabdomyoma cases due to the localization of the tumor and its infiltrative characteristics, even if there is an indication for a surgical operation. Sharing the experience in rare tumors is essential for the best medical care for those with this kind of rare tumor.

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