Evaluation of adult congenital heart diseases

Erişkinlerde görülen doğuştan kalp hastalıklarının değerlendirilmesi

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Objectives: Data on adult congenital heart diseases (CHD) are limited in Turkey. We evaluated the types and clinical features of CHDs in adult patients followed-up in our center.

Study Design: This study included 200 adult patients (age >16 years) who were diagnosed as having CHD in our clinic between April 2006 and January 2009. The patients were evaluated in three groups based on the complexity of adult CHD (simple, moderate, or great) according to the most recent ACC/AHA guidelines.

Results: There were 121 females (60.5%) and 79 males (39.5%). The mean age was 34.7±13.4 years (range 16 to 75 years) and female-to-male ratio was 1.53. The mean age was 32.8±14.0 years in males, and 36.0±12.9 in females. Nearly half of the patients were in the age groups of 20-29 years (n=46, 23%) and 30-39 years (n=49, 24.5%). According to the ACC/AHA criteria, 145 patients (72.5%) had simple CHD, 34 patients (17%) had moderate CHD, and 21 patients (10.5%) had severe-complex CHD. The mean age tended to decrease as the severity of CHD increased (35.7±13.7, 33.2±12.4, and 30.5±12.2 years, respectively). The most common adult CHD was atrial septal defect (n=105, 52.5%), followed by ventricular septal defect (n=34, 17%), Ebstein's anomaly (n=7, 3.5%), and Eisenmenger's syndrome (n=6, 3%). Aortic coarctation, transposition of the great vessels, patent foramen ovale, pulmonary stenosis, and aortic valve disease showed equal distribution with five patients (2.5%).

Conclusion: In our study, atrial and ventricular septal defects accounted for the majority of CHDs in adult patients (69.5%). Multicenter studies are required to determine the incidence of CHD among adult population in Turkey.

Key words: Adult; heart defects, congenital/epidemiology; prevalence.

Amaç: Ülkemizde erişkinlerdeki doğuştan kalp hastalıkları (DKH) üzerine yeterli çalışma bulunmamaktadır. Bu çalışmada, kliniğimizde izlenen erişkin hastalarda DKH'lerin dağılımı ve klinik özellikleri değerlendirildi.

Çalışma planı: Çalışmaya, Nisan 2006 ile Ocak 2009 tarihleri arasında kliniğimizde DKH tanısıyla izlenen ve 16 yaşından büyük 200 hasta alındı. Olgular son ACC/AHA kılavuzuna göre, basit, orta düzeyde ve ağırkarmaşık özellik taşıyan DKH olmak üzere üç grupta incelendi.

Bulgular: Hastaların 121'i kadın (%60.5), 79'u erkek (%39.5) idi. Yaş ortalaması 34.7±13.4 (dağılım 16-75), kadın/erkek oranı 1.53 bulundu. Erkeklerin yaş ortalaması 32.8±14.0 iken, kadınların yaş ortalaması 36.0±12.9 idi. Yaş grupları açısından, hastalar daha çok 20-29 (n=46, %23) ve 30-39 (n=49, %24.5) yaş gruplarında yoğunlaşmakta idi. ACC/AHA ölçütlerine göre, 145 hastada (%72.5) basit, 34 hastada (%17) orta, 21 hastada (%10.5) ağır-karmaşık DKH vardı. Yaş ortalaması hastalık ciddiyeti ilerledikçe azalma eğilimi gösterdi (sırasıyla 35.7±13.7, 33.2±12.4 ve 30.5±12.2). Erişkin hastalar içinde en sık rastlanan DKH atriyal septal defekt (n=105, %52.5) idi, bunu sırasıyla ventriküler septal defekt (n=34, %17), Ebstein anomalisi (n=7, %3.5), Eisenmenger sendromu (n=6, %3) ve beşer hastayla (%2.5) aort koarktasyonu, büyük arter transpozisyonu, foramen ovale açıklığı, pulmoner darlık ve aort kapak hastalığı izlemekteydi.

Sonuç: Bu çalışmada, erişkinlerde en sık görülen DKH tipi toplam %69.5 oranıyla atriyal septal defekt ve ventriküler septal defekt idi. Ülkemizdeki erişkin nüfusta DKH'lerin sıklığının belirlenmesi çokmerkezli çalışmalarla mümkün olacaktır.

Anahtar sözcükler: Erişkin; kalp defekti, doğuştan/epidemiyoloji; prevalans.

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Congenital heart diseases (CHD) are observed in eight out or every 1000 live birth.[1] Recent advances in medical and surgical treatment as well as in diagnosis has led to survival of more than 80% of individuals with CHD into adulthood.[2] It is estimated that about 800.000 adults have CHD in the USA, whereas 200.000 adults are thought to have CHD in Turkey.[3] In the analysis of a single centered study conducted in the UK on individuals who had CHD beyond 16 years of age[4], 200 patients with CHD were estimated to attain adulthood in every 100.000 live births.[5] Considering the fact that more than one million live births occur in Turkey every year, adult cardiologist are expected to encounter a large number of adult patients with CHD later in life.[6]

CHD in adulthood is known to show certain variations to that in childhood CHD. Many lesions turn to acquire various features during adulthood. The incidence of arrhythmias increases with different properties. Heart spaces frequently enlarge and the affinity of developing ventricular dysfunction increases.[7] The diagnosis of CHD may not be made until the development of a decrease in exercise tolerance, dyspnea and arrhythmias. The aim of treatment in these patients is to maintain hemodynamic stability and to prevent the development of complications such as heart failure and irreversible pulmonary vascular diseases.

In addition to diagnosis and treatment, our experience in the prevention of congenital heart diseases in adult patients is also limited. In a conference organized by the Canadian Cardiovascular Society in 1996 advances and management approaches to patients with CHD was discussed and a comprehensive report on this subject was published for the first time.[8,9] This was followed by the publication of the first guideline on CHD in adults after the 32nd Bethesda Conference of the American College of Cardiology in 2000.[3] This guideline was updated in the year 2008.[10]

There is a limited number of studies on adulthood CHD in Turkey. In this study we evaluated our experiences on adult patients who were being followed up for CHD in our clinic.

Table 1. Types of adult congenital heart diseases

Simple*	Moderate#	Severe-Complex†
Native disease	Aorto-left ventricular fistulas	Conduits, valved or non valved
Isolated aortic valve disease	Anomalous pulmonary venous drainage	Cyanotic cardiac defects (all forms)
Isolated mitral valve disease	(partial or total)	Double-outlet ventricle
(except parachute valve,	Atrioventricular septal defects	Eisenmenger syndrome
cleft leaflet)	(partial or complete)	Fontan procedure
Small atrial septal defect	Coarctation of the aorta	Mitral atresia
Isolated small ventricular	Ebstein's anomaly	Single ventricle (also called double inlet,
septal defect (no associated	Significant infundibular right ventricular	common inlet, or primitive)
lesions)	outflow obstruction	Pulmonary atresia (all forms)
Small patent foramen ovale	Ostium primum atrial septal defect	Pulmonary vascular obstructive disease
Mild pulmonary stenosis	Patent ductus arteriosus (not closed)	Transposition of the great arteries
Repaired conditions	Pulmonary valve stenosis (moderate to severe)	Tricuspid atresia
Previously ligated or occluded	Pulmonary valve regurgitation	Truncus arteriosus/hemitruncus
ductus arteriosus	(moderate to severe)	Other abnormalities of
Repaired secundum or sinus	Sinus of Valsalva fistula/aneurysm	atrioventricular or ventriculoarterial
venosus atrial septal defect	Sinus venosus atrial septal defect	connection not included
(without residua)	Subvalvular or supravalvular aortic	above (crisscross heart, isomerism,
Repaired ventricular septal	stenosis (except HOCM)	heterotaxy syndromes,ventricular inversion)
defect (without residua)	Tetralogy of Fallot	
	Ventricular septal defect with:	†*These patients should be seen regularly at adult congenital heart disease centers.*
**These patients can usually be cared for in the general medical community.*	- Absent valve or valves	
	- Aortic regurgitation	
	- Coarctation of the aorta	
	- Mitral disease	
	- Right ventricular outflow tract obstruction	
	- Straddling tricuspid/mitral valve	
	- Subaortic stenosis	
	#These patients should be seen periodically at regional adult congenital heart disease centers	

Source of table: Braunwald's Heart Disease 7th edition, Volume 2, Section 56. Istanbul: Nobel Tip Kitapevleri; 2008. pg. 1489-52.

PATIENTS AND METHODS

In this study we retrospectively investigated the distribution of CHD in adult patients observed at the same center and the demographic characteristics of the patients. A total of 200 patients aged more than 16 years old who were being followed up in our clinic between April 2006 and January 2009 with the diagnosis of CHD were included in the study. Patients who accepted to participate were given detailed information about the study. The necessary approval from the study was obtained from the Ethics Committee in our university.

Patients were divided into three groups as mild, moderate and severely complex CHD according to the latest ACC/AHA guidelines (Table 1).[10] Characteristics of patients in these group, and the distribution of gender and age according to incidence and diagnosis of CHD was investigated.

All patients suspected of having CHD primarily underwent transthoracic echocardiography. The right and left ventricular function, rate of right and left shunt, pulmonary artery pressure and the CHD type were registered during the transthoracic echocardiography in case of any suspicion of CHD. Following investigation by transthoracic echocardiography all patients who suspected of having CHD were evaluated using transesophageal echocardiography (TEE). The Vivid 7 (GE) echocardiography device and the 6 MHz probe were used in this investigation.

RESULTS

Of the patients with CHD, 121 were female (60.5%), while 79 were male (39.5%). The mean age was 34.7±13.4 years (range 16 to 75 years) and the female-to-male ratio was found to be 1.53. The mean age was 32.8±14.0 years in males, and 36.0±12.9 in females. Majority of the patients were in the age groups of 20-29 years (46 patients, 23%) and 30-39 years (49 patients, 24.5%). The number of patients was found to decrease and their mean age tended to decrease as the severity of the disease increased. Distribution of male and female patients according to age group is shown in Table 2.

Evaluation of the patients according to the ACC/AHA guidelines demonstrated that 145 patients (72.5%) had simple CHD, 34 patients (17%) had moderate CHD, while 21 patients (10.5%) had severe-complex CHD. The mean age tended to decrease as the severity of the disease increased (35.7±13.7, 33.2±12.4, and 30.5±12.2 years, respectively). Distribution of the patient groups according age groups was found to be consistent (Figure 1).

Table 2. Distribution of patients according to age groups

	Total	%	Females	%	Males	%
10-19	36	18.0	15	41.7	21	58.3
20-29	46	23.0	28	60.9	18	39.1
30-39	49	24.5	36	73.5	13	26.5
40-49	38	19.0	21	55.3	17	44.7
50-59	22	11.0	16	72.7	6	27.3
60-69	8	4.0	5	62.5	3	37.5
70-79	1	0.5	-		1	100.0

The most commonly seen adult CHD was atrial septal defect (ASD) (n=105, 52.5%) (Table 3). This was followed by ventricular septal defect (VSD) (n=34, 17.0%), Ebstein's anomaly (n=7, 3.5%), and Eisenmenger's syndrome (n=6, 3.0%), as well as an equal distribution of aortic coarctation, transposition of the great vessels, patent foramen ovale, pulmonary stenosis, and aortic valve disease in five patients (2.5%) Table 3.

The lowest mean age was found in patients with pulmonary stenosis (20.8±3.6), aortic valve disease (21.4±8.2), and aortic coarctation (24.0±12.3). On the other hand, the highest mean age was found in the group of patients with patent foramen ovale (42.8±19.9), and ASD (39.4±13.0) (Table 3). Evaluation according to gender demonstrated that the rate of females was higher, particularly in the ASD group (Table 3).

Complaints at presentation in patients with simple CHD were mostly palpitation, dyspnea, and less frequently chest pain, and syncope, whereas those of patients with moderate and severe-complex CHD were mostly exercise intolerance, palpitation, cyanosis, syncope, and less frequently hemorrhagia, thromboembolic and infectious complaints.

DISCUSSION

Although it is relatively a less commonly encountered disease, CHD when left untreated may limiting

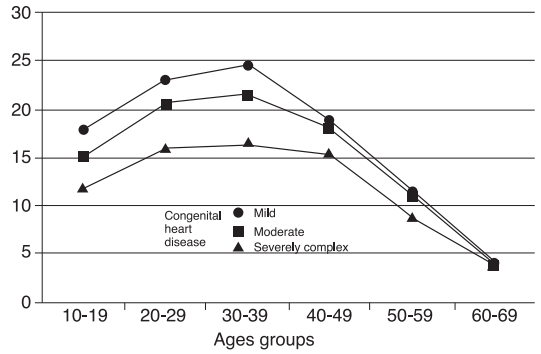

Figure 1. Relationship of the severity of congenital heart diseases with age groups.

Table 3. Distribution of congenital heart diseases according to diagnoses and the mean age of patients

	Total	%	Mean age	Females	%	Males	%
Atrial septal defect	105	52.5	39.4±13.0	68	64.8	37	35.2
Ventricular septal defect	34	17.0	27.2±8.7	18	52.9	16	47.1
Ebstein's anomaly	7	3.5	33.7±12.6	2	28.6	5	71.4
Eisenmenger syndrome	6	3.0	28.3±9.6	4	66.7	2	33.3
Coarctation of the aorta	5	2.5	24.0±12.3	1	20.0	4	80.0
Transposition of the great arteries	5	2.5	37.8±18.2	3	60.0	2	40.0
Patent foramen ovale	5	2.5	42.8±19.9	2	40.0	3	60.0
Aortic valve disease	5	2.5	21.4±8.2	4	80.0	1	20.0
Pulmonary stenosis	5	2.5	20.8±3.6	2	40.0	3	60.0
Tetralogy of Fallot	3	1.5	39.2±11.2	2	66.7	1	33.3
Single ventricle	3	1.5	37.0±7.2	2	66.7	1	33.3
Atrioventricular septal defect	3	1.5	37.3±11.7	1	33.3	2	66.7
Other cardiac lesions*	14	7.0	29.0±12.9	12	85.7	2	14.3
Total	200	100.0	34.7±13.4	121	60.5	79	39.5

*Patent ductus arteriosus (n=2), sinus of Valsalva fistula (n=2), conduits (n=2), truncus arteriosus (n=2), mitral valve disease (n=1), infundibular right ventricular outflow obstruction (n=1), supravalvular aortic stenosis (n=1), double-outlet ventricle (n=1), Fontan procedure (n=1), tricuspid atresia (n=1)

the patients survival by posing a mortality and morbidity risk. The first center to start treating adult patients with CHD was created in Canada in the 1960s. From the 1970s the number of centers providing such services started to increase. The incidence of CHD in live birth is known to be around 0.8% western countries as well as in Turkey.[11-14] Advances in medical and surgical treatment in the past 40-50 years as well as in diagnosis has led to survival of more than 80% of individuals with CHD into adulthood.[2] The number of patients with adult CHD is estimated to outweigh that of childhood CHD in the near future.

There are very few studies in Turkey investigating the incidence of CHD patients.[15] Kursaklioglu et al.[16] found the incidence of CHD among 20-22 year-old male patients in Turkey to be around 0.07%, and demonstrated that most commonly encountered CHD was ASD (35%), which was followed by VSD (26%), pulmonary stenosis (13%), tetralogy of Fallot (4.7%), and patent ductus arteriosus (4.5%). Our study also demonstrated that ASD (52.5%) was the most common CHD, followed by VSD (17.0%), Ebstein's anomaly, Eisenmenger syndrome, coarctation of the aorta, transposition of the great vessels, patent foramen ovale, pulmonary stenosis, and aortic valve disease. Coarctation of the aorta, Ebstein's anomaly, patent foramen ovale, pulmonary stenosis, and atrioventricular septal defect were found to be more common in males, whereas the others were more commonly seen in females.

Atrial septal defect is the most common CHD in adults.[6] These patients mostly present with complaints of fatigue, exercise intolerance, dyspnea, and palpitation. ASD was also the most common finding in our study (52.5%), and these patients were the most elderly group after patients with patent foramen ovale (Table 3). In this group the number of females was 68 (64.8%), number of males was 37 (35.2), whereas the female/male ratio was 1.83. Literature studies as well as our study have demonstrated that CHD is most common in females. The study by Kursaklioglu et al.[16] does not actually represent the incidence and variety of CHD in Turkey since it includes only male patients. The incidence of ASD in our study was found to be higher when compared to the other literature studies. The reason may be due to use of the transcatheter method for the closure of ASD in our center leading to many patients visiting our clinic. In the study conducted by Uzun et al.[17] on ASD patients in 2007 the most common type of ASD was ostium secundum (82%), which was followed by the sinus venosus (12%) and the ostium primum (7%) types. Literature studies also show that ostium secundum is the most common type (75%), followed by ostium primum (15%) and sinus venosus (10%).[18] On the other hand, the coronary sinus type is very rarely (less than 1%) seen. Of 105 patients with ASD the ostium secundum type was found in 99 (94.3%) patients, sinus venosus type in 4 (3.8%) patients, and the ostium primum type in 2 (1.9%) patients. The high incidence of the secundum type of ASD and closure of this type by the percutaneous route may be due to the fact that our center is a reference center.[19]

Ventricular septal defect is seen at the rate of 0.30-0.35% in babies and is the most common childhood

CHD.[20] However, the incidence of VSD in adults is decreasing with time due to spontaneous closure of childhood VSD. The perimembranous type is the most common (70-80%) of isolated VSDs, followed by the muscular type (20-25%).[21] The incidence of patients with VSD in our study was 17%. Of the patients 18 were female with female/male ratio was 1.1, and a mean age of 27.3±8.7 (Table 3). The perimembranous type was observed in 29 of these patients (85.3%), whereas the muscular type was found in five of the patients (14.7%). Of note, the most common symptom in patients with VSD is effort dyspnea and exercise intolerance. The severity of symptoms varies according to the extent of the defect, degree of left-to-right shunt, increase in pulmonary artery pressure and resistance. Closure of VSD in these patients buy surgical or the transcatheter method should be evaluated before the development of Eisenmenger syndrome.

Ebstein's anomaly is a rarely seen congenital anomaly and is encountered in 0.6% of patients with CHD.[22] Most patients present with symptoms of right heart failure and cyanosis at an early age due to right-to-left shunt. However, patients who attain adulthood present with tiredness, dyspnea, palpitation, and presyncope. Among patients with congenital heart disease Wolff-Parkinson-White (WPW) syndrome is mostly seen in those with Ebstein's anomaly. Of the 7 patients diagnosed with Ebstein's anomaly in our clinic three of them underwent electrophysiology studies due to diagnosis of WPW and ablation was performed for supraventricular tachycardia.

Transposition of the great arteries is seen in 7-8% of cases with CHD.[23] Transposition of the great arteries is defined as the entire or most of the aorta emerging from the right ventricle, together with the entire or most of the pulmonary artery emerging from the left ventricle. Patients generally present with nonspecific complaints such as tiredness, dyspnea, effort intolerance and presyncope. Survival in these patients is near normal with a timely and appropriate surgical intervention. The five patients with transposition of the aorta also underwent early corrective surgery.

Coarctation of the aorta is found in 6-8% of patients with CHD.[24] Hypertensive young adults should carefully be evaluated particularly for coarctation of the aorta since patients with this condition are frequently asymptomatic until adulthood. The main complaints include headache, epistaxis, weakness in the legs, whereas severe patients present with signs of angina and heart failure. Five patients who were being followed up for coarctation of the aorta formed one of the youngest patient groups (mean age 24.0±12.3). Another characteristic of this group was the higher number of male patients (80%). Percutaneous route stent-grafting was performed in 2 of the patients in this group, whereas surgical treatment was also administered one patient.

Left ventricular outflow obstruction consists of aortic valve diseases, subvalvular and supravalvular aortic stenosis. The main symptoms include exercise intolerance, tiredness, angina pectoris, orthopnea and syncope. They constitute 3-8% of congenital heart diseases.[25] Almost 60% of these are aortic valve diseases. Seven patients in our study were of this group. Aortic valve disease was found in 5 of these patients, whereas there was supravalvular aortic stenosis in the other 2.

Tetralogy of Fallot is observed at the rate of 3-6 in every 10.000 births, and constitute 5-15% of the CHDs.[26] Survival of these patients into adulthood depends on corrective surgery due to the development of progressive hypoxia during the early years of life. Complaints of palpitation, effort dyspnea, findings of right heart failure, presyncope and syncope may be observed. Patients may develop central cyanosis depending on the degree of ventricular outflow obstruction, in the absence of corrective surgery. Three patients were being monitored in our study.

Atrioventricular septal defect constitutes 3-5% of CHDs.[26] There are two main group, partial or complete with the partial form being the most common. Atrioventricular septal defect is more commonly seen together with certain congenital heart diseases (Ellis-van Creveld syndrome, Down syndrome, asplenia and polysplenia syndrome). Complaints of fatigue, exercise intolerance, palpitation and cyanosis may also be reported in adult patients.

Pulmonary stenosis constitues of 7-12% of CHDs and make up 80-90% of right ventricular outflow obstructions.[27] Adult patients present with symptoms of right heart failure and effort dyspnea. Patients with this condition consisted of the youngest group in our study (mean age of 20.8±3.6). Four of these patients underwent pulmonary balloon valvuloplasty.

The single ventricle is a rare congenital cardiac anomaly and constitute 1% of all congenital heart defects.[28] The number of patients who attain adulthood is very small due to the very poor prognosis in untreated cases. There is an increase in the rate of hospitalization of these patients due to the development of arrhythmia and heart failure in 20-30 year-old patients.

In a prospective, multicenter study conducted by Kaemmerer et al.[29] during a one-year follow-up period adult CHD patients who visited the emergency department presented with the following complaints in the order of fre-

quency: Arrhythmia (37%), acute heart failure (26%), infection (11%), syncope (5%), thromboembolism (4%), chest pain, hemorrhagia and cardiac arrest. The main reason for hospitalization in these patients is arrhythmia and are the cause of increase in mortality and morbidity.[30] The type and frequency of arrhythmias in most of these patients varies especially due the surgical operation and the change in cardiac anatomy. Atrial arrhythmias are the most common, followed by ventricular tachycardia, sudden death and atrioventricular blocks. In addition to the medical treatment administered in these patients, cardiac pacemakers, implantable cardioverter defibrillator (ICD), ablation procedures and when necessary surgical interventions are performed by experienced cardiologist.

Some patients with adult CHD develop cyanosis due to right-to-left shunt. Cyanosis was observed in 11 (5.5%) patients in our study. In a study conducted by Engelfriet et al.[31] at 72 European centers on 4110 adult CHD patients, the lowest survival rate (87.4%) was observed in patients with cyanotic defects. Due to severe hematologic abnormalities which arise due to the developing hypoxia, a multidisciplinary approach should be used in the management of patients with cyanotic defect. Symptoms of hyperviscosity, exercise intolerance and changes in atrial saturation should carefully be monitored in patients who develop cyanosis, and these patients should receive prophylaxis for endocarditis and pneumococcal infections. These patients should also be evaluated for palliative surgical interventions (Blalock-Taussing shunt, Potts shunt, Glenn shunt, etc.) and transplantation when necessary. Adults with congenital heart diseases should receive detailed information about pregnancy, choice of profession, effort capacity and lifestyle. Most female patient may tolerate pregnancy through closed follow-up.[32] Pre-conceptional genetic counseling and functional capacity should be evaluated in detail in these patients. Risk evaluation of the patients should be performed and patients should informed about birth control particularly in the high risk group of patients (Eisenmenger syndrome, severe aortic stenosis and coarctation, pulmonary hypertension, cyanotic heart disease and left ventricular ejection fraction of <%35). Pregnancy should be terminated when necessary.

Recent guidelines emphasize the presence of an experienced transitional clinic as the first stage in the successful management of adult patients with CHD. Adult cardiologists are not very experienced in the management of adult CHD patients due to the complexity and wide spectrum of problems which may arise in these patients. On the other hand, pediatric cardiologists should not be expected to provide medical treatment for adult in a pediatric medical environment. As a result, it is necessary for adult and pediatric cardiologists to work hand-in-hand.

Although the single-centered nature of this retrospective study may act as a limitation to the study, the absence of detailed studies on adult CHD patients in Turkey places great importance to this study and may act as an incentive for further studies on the topic. Multicenter studies are required to establish the incidence of CHD in the Turkish adult population.

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