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Research Article

Congenital heart defects and associated comorbidities – 5 years of experience

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Abstract. Objective: Cardiovascular malformations are a common cause of neonatal and infant death. We undertook this study to determine the prevalence and spectrum of cardiovascular malformations in a pediatric population, the prevalence of other associated anomalies and genetic syndromes among infants with cardiovascular malformations. Material and Methods: We based the study on a pediatric population admitted at the 2nd Clinic of Pediatrics, for a period of 5 years, diagnosed with a congenital heart defect (CHD). We determined the onset and the incidence of the pathology, as well as its association with other syndromes and defects. Results: The most frequently encountered type of CHD was atrial septal defect (30%), followed by ventricular septal defect (15%), valve defects (15%), tetralogy of Fallot (11%), patent ductus arteriosus (10%), common atrioventricular canal (5%), transpositions of the great vessels (2%), coarctation of the aorta (4%) and other types of congenital heart defects (8%). One hundred and three (38.72%) of the patients with confirmed CHD diagnosis suffered from complex heart defects. Congenital heart defects most often associated bone and muscle defects (8%) and craniofacial deformities (8%), while the lung malformations - CHD association is the rarest (2%). 233 of the patients included in the group under study did not suffer from chromosome abnormalities (87.59), while the highest incidence (9.77%) was recorded for Down syndrome, which affected 26 children. Conclusion: Despite the improvement in the diagnosis and treatment of CHD, there is still a large prevelance in pediatric patients. With the success of contemporary surgical procedures, many patients are able to reach adult life.

Key Words: congenital heart defects, genetic syndrome, children.

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Introduction

Congenital heart diseases (CHD) affects 6-8 babies in every 1000 live births. Half of them have minor abnormalities that have no functional impact and rarely affect the well being or require intervention. More patients with CHD require treatment each year than those with other significant conditions. About a quarter of those requiring treatment will need surgery in the first year of life. Most infants and children requiring single interventions can expect to live a near-normal life. A small group of infants with complex lesions require multiple surgical procedures, intensive support and close monitoring. With the success of contemporary surgical procedures and improved survival, many patients with complex lesions are reaching adult life (Wessels *et al* 2010). Despite the improvement of treatment and prognosis of these patients, there is lack of knowledge of the ethiology of CHD. Currently, about 20% of CHD may be caused by teratogens or a genetic condition, but little is known about the rest (Ross-Hesselink *et al* 2005).

Material and methods

We carried out a descriptive study over a period of five years (from 2007 until 2011) on patients admitted in the 2nd Clinic of Pediatrics Cluj-Napoca. The study was carried out on 266 children diagnosed with congenital heart defects based on their echocardiogram. We determined the onset and the incidence of the pathology, as well as its association with other syndromes and defects. We analyzed symptomatology and gathered data on the age at which the congenital heart defects were diagnosed, as well as other data regarding the optimal age for performing surgical treatment and their therapeutic attitude.

Results

Two hundred and sixty six (266) patients from the 2nd Clinic of Pediatrics Cluj-Napoca, aged between 7 days and 18 years old, admitted between January 2007 and August 2011 were included in the study, as follows: 23 patients in 2007, 98 patients in 2008, 42 patients in 2009, 57 patients in 2010 and 46 patients in 2011. Out of the admitted patients, 36% are infants, followed

by preschoolers (16%), toddlers and older children (both accounting for 14% of the total number), newborns (9%) and children having reached puberty and adolescence (7% and 4% respectively). The most frequently encountered type of CHD is atrial septal defect (ASD) (30%), followed by ventricular septal defect (VSD) (15%), valve defects (15%), tetralogy of Fallot (11%), patent ductus arteriosus (PDA) (10%), common atrioventricular canal (5%), transpositions of the great vessels (2%), coarctation of the aorta (CA)(4%) and other types of congenital heart defects (8%) see Table 1.

Table 1.Types of congenital heart defects

Type of defect	Number
ASD	79
VSD	40
Tetralogy of Fallot	30
Patent ductus arteriosus	27
Common atrioventricular canal	14
Coarctation of the aorta	10
Transposition of the great vessels	5
Valve defects	40
Others	21

Table 2. Association of multiple congenital heart defects

Associated CHDs	Number
Bicuspid aortic valve ± aortic stenosis ± aortic regurgitation	12
ASD + VSD	8
VSD + PDA	8
ASD + PDA	9
VSD + tricuspid regurgitation	9
Tetralogy of Fallot+ atresia/hypoplasia of the pulmonary artery	8
ASD + tricuspid regurgitation	7
VSD + ASD + PDA	5
CA + PDA	5
Common atrioventricular canal + PDA + pulmonary stenosis	4
ASD + pulmonary stenosis	4
Associated valve defects	5
PDA + valve defects	3
Common atrioventricular canal + ASD	3
Bicuspid aortic valve + coarctation of the aorta	3
VSD + pulmonary stenosis	3
VSD + ASD + coarctation of the aorta	2
Coarctation of the aorta + common atrioventricular canal	2
VSD + Coarctation of the aorta	1

One hundred and three (38.72%) patients with confirmed CHD diagnosis suffer from complex heart defects and 163 (61.28%) from simple heart defects. The most frequent association is the one between bicuspid aortic valve and stenosis or aortic regurgitation (11.65%), followed by the atrial septal defect – patent ductus arteriosus and the ventricular septal defect – tricuspidic regurgitation associations, each diagnosed in 9 patients (8.73%). 7.76% suffer from the tetralogy of Fallot – atresia/hypoplasia of the pulmonary artery association. The rarest association is the one between ventricular septal defect and coarctation of the aorta, association encountered in only 1 patient (0.97%). The other associations are listed in Table 2.

Congenital heart defects most often associates bone and muscle defects (8%) and craniofacial deformities (8%). 5% of the patients suffer from gastrointestinal anomalies, 4% of the patients from renal and genital anomalies. Hemangiomas and ophtalmological abnormalities each affect 3% of the patients under study, while the lung malformations - CHD association is the rarest (2%). Nevertheless, 70% of the patients do not suffer from any type of association with other anomalies (Figure 1).

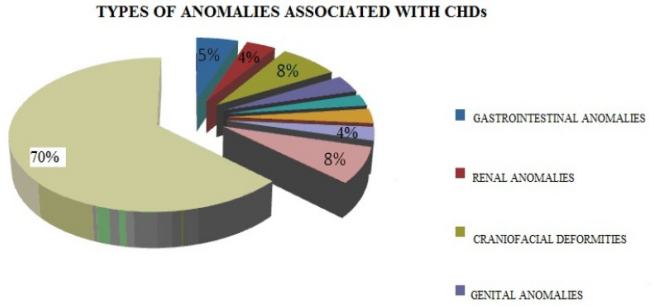

Figure 1. Percentage distribution of anomalies associated with CHDs

Two hundred and thirty-three of the patients included in the group under study did not suffer from chromosome abnormalities (87.59%), whereas 12.4% of these patients did suffer from this type of pathology. The highest incidence (9.77%) was recorded for Down syndrome, which affected 26 children. The Turner syndrome affected 2 patients (0.75%). Five patients (1.6 %) suffered from other types of syndromes, such as: Noonan syndrome, type 1 congenital dyserythropoietic anemia, Marfan syndrome and Pierre-Robin sequence (Figure 2).

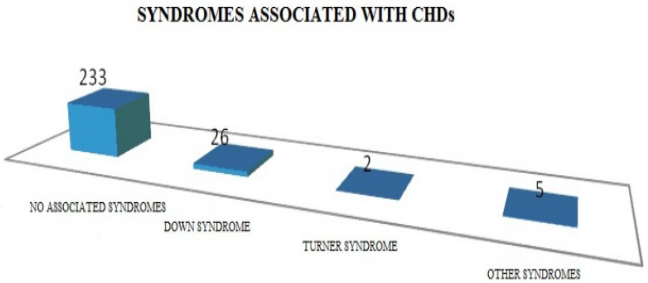

Figure 2. Numerical distribution of the syndromes associated with congenital heart defects.

Discussions

Congenital malformations are known to be one of the leading causes of death in newborns (Petrini *et al* 2002). CHDs are an

important subgroup of these since they carry a high risk of mortality and morbidity. The causes of CHD are complex and could be considered as chromosomal, single gene mutations or multifactorial. Though the prevalence has been reported to vary from 3.9 to 11.9 per 1,000 live births, the rate may be as high as 10-fold in the series including primarily the autopsy materials. In a recent study, Tennsted et al found a CHD in 129 fetuses of the 815 fetuses examined (16%), which is slightly higher than the incidence reported for CHD in necropsies on newborns varying between 6%-13%. In our study most patients admitted with congenital heart defects were infants, followed by toddlers, preschoolers and newborns. The lowest incidence was recorded in children who reached puberty and adolescence. The high number of infants admitted showed a relatively early diagnosis of the patients suffering from this type of pathology. However, it should be noted that, in developed countries, congenital heart defects are often caught during the neonatal phase or at birth. The atrial septal defect is among the most frequent congenital heart defects, followed by ventricular septal defect, tetralogy of Fallot, patent ductus arteriosus and valve defects (aortic insufficiency, aortic stenosis, respiratory failure, pulmonary stenosis, stenosis of the atrioventricular valves and atrioventricular valve regurgitation). Many congenital heart defects are simple. Still, a significant number of CHDs are complex. In the group under study, the most frequent association was the one between bicuspid aortic valve and aortic regurgitation and/or aortic stenosis. Other frequent associations included: the ventricular septal defect - atrial septal defect or patent ductus arteriosus association, the ventricular septal defect – tricuspid regurgitation association, the tetralogy of Fallot – atresia or hypoplasia of the pulmonary artery association, the atrial septal defect – tricuspid regurgitation association, the atrial septal defect – ventricular septal defect and patent ductus arteriosus associations, the association between different valve defects and the coarctation of the aorta - patent ductus arteriosus association. The incidence rate of the atrial septal defect – pulmonary stenosis and of the common atrioventricular canal – pulmonary stenosis and patent ductus arteriosus associations is of 5%. There are, of course, some predispositions in the way in which the associations between the various types of defects are formed, but many of them are at the origin of new defects.

The largest part of congenital heart defects do not associate with other types of abnormalities, but when they do, the most frequent associations are made with: craniofacial deformities, bone and muscle defects, gastrointestinal, renal, genital abnormalities, hemangiomas, ophthalmological abnormalities and lung malformations. This is possibly caused by syndrome coexistence, toxin consumption or exposure of the mother to teratogens in some of the key moments of the development of the fetus.

As far as syndromes are concerned, the highest incidence rate is recorded for Down syndrome, followed by the Turner syndrome and the Noonan, Marfan and Pierre Robin syndromes. The causes of CHD remain largely unknown. Aneuploidies such as trisomy 21 (causing Down syndrome) are strongly associated with CHD (Goldmuntz *et al* 2011). This became apparent in the 1990s with the discovery of 22q11.2 deletions, which were found to underlie roughly 2% of CHD (excluding BAV) and more than 50% of specific conotruncal lesions (Goldmuntz *et al* 1998). The use of technologies that detect copy number variants (CNVs) has uncovered numerous other segmental aneuploidies that cause CHD (Richards *et al* 2008). Genetic factors, specific embryological mechanisms and cell characteristics can determine the type of cardiac malformation in these patients (Soemedi *et al* 2012). Nevertheless, ethnic and geographic factors may also influence the formation of these abnormalities (Rubens Figueroa *et al* 2003).

Conclusions

Congenital heart defects can have still a large prevelance in infants, with a multifactorial determination, can arise from multiple combinations of genetic and environmental factors. CHD can be associated with extracardiac anomalies and with chromosomal abnormalities. There is a variable expression of phenotype for each syndrome, therefore we can observe a large range of possible cardiac lesions.

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