CONGENITAL HEART MALFORMATIONS IN NEWBORN BABIES WITH LOW BIRTH WEIGHT

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CONGENITAL HEART MALFORMATIONS IN NEWBORN BABIES WITH LOW BIRTH WEIGHT (Abstract): congenital heart malformations represent a public health problem, holding a significant percentage of the total of heart diseases. Beside the elevated frequency of the malformations, we also notice their occurrence in newborn babies with low birth weight, increasing, thus, the risk of complications and late therapeutic approach. The goal of the study was to highlight the general and particular aspects of cardiovascular malformations epidemiology in newborn babies with low weight at birth, the correlation of the malformations with implied genetic and environmental factors, assessing the complications and their procedures on the therapeutic management.

Material and methods: Our study was performed on a group of 271 patients, hospitalized in the Department of Pediatric Cardiology of “Sf. Maria” Emergency Clinical Hospital for Children of Iasi, during January 2011 – December 2013. The patients were assessed based on anamnesis, clinical, biological and imagistic exam.

Results: The study lot was divided according to the type of the structural defect: 95% of the patients were diagnosed with non-cyanogenic congenital heart malformations and 5% with cyanogenic congenital heart malformations. Regarding the patient’s origin background, we notice an elevated frequency of the rural environment (71%). The incidence of the malformations was high in premature low birth weight (48%), followed by premature very low birth weight (22%). In evolution, congenital heart malformations often get more complicated heart failure, arterial hypertension and respiratory infections being most often met. Mortality was maximum in the first year of life, a third of the cases being associated with chromosomal malformations. Conclusions: Congenital heart malformations in newborn patients with low weight at birth represented an elevated percentage of 44.13% of the total of the cases hospitalized for cardiovascular diseases from the Department of Pediatric Cardiology of Iasi. Many cases were associated with other congenital malformations or different complications, being necessary an interdisciplinary collaboration to adequately monitor the anatomical and functional parameters and to ensure a somatic and mental development as normal as possible. Keywords: CONGENITAL HEART MALFORMATIONS, LOW WEIGHT AT BIRTH, COMPLICATIONS

Congenital heart malformations are the result of an abnormal embryogenesis, characterized by structure or function anomalies of the cardiovascular system (1). Of a big importance is the early diagnosis, before the settlement of the irreversible complications that create a vicious circle on infantile mortality and morbidity. Each
year in Romania over 20,000 prematurely born babies and new-born babies with low weight at birth are registered. Prematurity and its complications are accountable for more than a half of the neonatal deaths, representing one of the main causes of neonatal mortality in our country (3).

**MATERIAL AND METHODS**

The study was retrospectively performed on a group of 271 newborns with low weight at birth within the Department of Pediatric Cardiology of “Sf. Maria” Emergency Clinical Hospital for Children of Iasi, during January 2011 - December 2013. All patients were anamnestically, clinically, biologically and imagistically examined, being divided in 2 sub-groups: non-cyanogenic congenital heart malformations and cyanogenic congenital heart malformations.

**RESULTS**

In this study, the cases with congenital heart malformations in newborns with low weight at birth represented 44.13% of the total of cases hospitalized for cardiovascular diseases in the Department of Pediatric Cardiology of “Sf. Maria” Emergency Clinical Hospital for Children of Iasi, in the chosen period. From the background environment point of view, 192 (71%) patients came from rural environment and 79 (29%) patients from urban environment. Maternal anamnesis showed that 50% of these are young mothers (16-30 years of age) and only a percentage of 28% presents extreme ages (36-49 years of age). The incidence of malformations proportionally varied with age, being higher in the premature low birth weight (48%), very low birth weight (22%), extremely low birth weight (6%).

The analysis of maternal pathology with possible teratogenic implications demonstrated that chronic diseases were present in 21 (7.58%) in the mothers of the children diagnosed with congenital heart malformations: DZ (6 cases), hypothyroidism, (6 cases), epilepsy (2 cases), HTA pregnancy pre-existence (8 cases), TBC (1 case). Anti-epileptic and tuberculostatic chronic medication during pregnancy was present in 1% of the cases, alcohol chronic consumption – 0.8% and viral infections (rubella, varicella, toxoplamosis, TORCH infections) - 2%.

The study group was divided according to the type of structural defect (fig. 1): 95% non-cyanogenic congenital heart malformations and 5% cyanogenic congenital heart malformations.

In the non-cyanogenic congenital heart malformations subgroup, the highest frequency was met in atrial septal defect cases (with a percentage of 43.10), the majority being of OS type. As frequency, patent ductus arteriosus (23.28%) follows, than ventricular septal defect (13.36% - with localization on membranous septum level in most of the cases). The anomalies of the right ventricle exit tract (pulmonary valve stenosis) were presented in 7.54% of the cases and the anomalies of the left ventricle exit tract in 7.76% of the cases, of which 4.31 % presents aortic stenosis (of bicuspid valve type) and 3.45% presents coarctation of aorta (fig.2).

Upon sex repartition, we noticed a slight increase in favor of the males, (59% - the most frequent being diagnosed with ventricular septal defects, patent ductus arteriosus, pulmonary valve stenosis, coarctation of the aorta and atrio-ventricular canal defects; the females were noted in 41% of the cases being diagnosed in most of the cases with aortic stenosis (fig.3).
Congenital heart malformations in newborn babies with low birth weight

Subsequent to the analysis of the anamnestic data regarding babies’ gestational age and weight at birth, we notice that half of them had grade I prematurity, followed in equal proportions by cases with grade II prematurity and dismaturity.

The analysis of the electrocardiograms demonstrated that the majority of the patients were in sinus rhythm -97.37% and only 2.63% had irregular rhythm (atrial fibrillation). At the analysis of QRS complex morphology we noticed axis changes (16% - axis on the right 5% - axis on the left), atrial and ventricular hypertrophies and interventricular blocks (fig.4).

In evolution, non-cyanogenic CHM often complicated with IC, followed by pulmonary hypertension and respiratory condi-
A number of 76 (17%) patients of the study subgroup were diagnosed with other congenital malformations. The analysis of associated genetic syndromes showed a predominance of chromosomal syndromes - 30 (6%) cases compared to monogenic ones - 4 (0.89%) cases.

**Fig. 4.** Case repartition according to the electrocardiographic modifications

**Fig. 5.** Graphical repartition of the complications in patients diagnosed with non-cyanogenic congenital heart malformations

### TABLE I

**Genetic syndromes detected in children with non-cyanogenic congenital heart malformations**

<table>
<thead>
<tr>
<th>Chromosomal syndrome</th>
<th>Associated non-cyanogenic CHM</th>
<th>Number of total cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Down</td>
<td>DSA OS</td>
<td>20</td>
</tr>
<tr>
<td>DiGeorge</td>
<td>DSA OS</td>
<td>4</td>
</tr>
<tr>
<td>Edwards</td>
<td>DSV</td>
<td>2</td>
</tr>
<tr>
<td>Turner</td>
<td>St AO</td>
<td>1</td>
</tr>
<tr>
<td>Cri du chat</td>
<td>PCA</td>
<td>1</td>
</tr>
<tr>
<td>Williams</td>
<td>St AP</td>
<td>1</td>
</tr>
<tr>
<td>Waardenburg</td>
<td>Co AO</td>
<td>1</td>
</tr>
</tbody>
</table>

**Monogenic syndromes**

<table>
<thead>
<tr>
<th>Monogenic syndromes</th>
<th>Associated non-cyanogenic CHM</th>
<th>Number of total cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marfan</td>
<td>DSA OS</td>
<td>1</td>
</tr>
<tr>
<td>Ehler Danlos</td>
<td>DSA OS</td>
<td>1</td>
</tr>
<tr>
<td>ADPKD</td>
<td>CAV</td>
<td>1</td>
</tr>
<tr>
<td>Dandy Walker</td>
<td>DSA OS</td>
<td>1</td>
</tr>
</tbody>
</table>
In the study subgroup of the cases with cyanogenic congenital heart disease, we noticed an increased frequency of cases with tetralogy Fallot (45%), followed by big vessel transposition (24%), Fallot pentality (19%). 0.2% of the total congenital heart disease represented the percentage in common for the cases that were diagnosed with common arterial trunk and sole ventricle (1 case each) (fig.6).

Repartition on sexes of cyanogenic congenital heart disease showed a slight difference in favor of the females (57%); males (43%) are especially met in cases diagnosed with transposition of the great arteries and sole ventricle (fig.7).

The X-ray exam brought a major contribution in Fallot tetralogy diagnosis (cord en sabôt-73% accompanied by pulmonary hyper-transparent - 55%) and transposition of the great arteries (narrowed superior mediastine 67%, ovoid heart 83% and pulmonary stasis 50%). In cases with sole ventricle and common arterial trunk, only an enlarged diameter of the heart and stasis aspect were described, requiring, thus, additional investigations.

At the analysis of the electrocardiograms, in 67% of the cases, we notice the deviation of the axis to the right, and in only 16% the intermediate axis. Right ventricular hypertrophy is presented in 7 cases of Fallot tetralogy of the 10 (64%) diagnosed, in 4 cases of transposition of the great arteries of the 6 (30.77%) non-diagnosed (30.77%) and in 1 case of Fallot Pentalogy of the 4 (25%) diagnosed. Biventricular hypertrophy was met in the case of the sole ventricle and common arterial trunk.

Three cases of syndromes were associated with other genetic syndromes: 2 cases with Di George syndrome and 1 case with fetal alcohol syndrome. Between 2011-2013, 18 children of non-cyanogenic CHM
group were operated (the most frequent defects being: DSV - 6 cases, PCA - 4 cases, and some 2 cases of CAV, Co AO, DSA, St AO), and 4 children were operated form the cyanogenic CHM group (3 cases with Fallot tetralogy and a case of TVM). An increased frequency of the surgery procedure was noticed in 2012 (fig.8).

![Distribution on years of the corrective surgery procedure](image)

The results of the anatomical and pathological exam were analyzed in 24 cases of the study group who died in the Department of Pediatric Cardiology of “Sf. Maria” Clinical Hospital for Children of Iasi during 2011-2013 and were confirmed by necropsy with congenital heart defect. The mortality of the cases diagnosed with congenital cardiovascular malformations was the maximum in the first year of life, when 96% of total number of deaths of the children with congenital heart defect was recorded. In the first week of life, 8% of the deaths of the children with congenital heart defect took place, and in the first month, half of deaths recorded in the first year (42%) (tab. II).

Regarding the sex of the deceased children with CHM, we notice a slight predominance of the males (13 cases - 54%). Congenital heart malformations that are the most implicated in tanatogenesis were represented by transposition of great arteries (40%), Fallot Tetralogy (25%) and atrioventricular canal defect (20%). One should note that, of the 24 deaths, a third was associated to chromosomal syndromes: Down syndrome (6 cases) and Edwards’s syndrome (2 cases).

**TABLE II**

Death distribution in children with CHM according to the age the death took place

<table>
<thead>
<tr>
<th>Weeks</th>
<th>Months</th>
<th>3-12</th>
<th>&gt;1</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1</td>
<td>1</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>Number of cases</td>
<td>2</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Percentage</td>
<td>8</td>
<td>42</td>
<td>17</td>
</tr>
</tbody>
</table>

**DISCUSSION**

Romania has got a prematurity indicator higher than many EU countries, the percentage of the babies born before 28 weeks and under 1,000 grams is approximately 1 – 1.5% of the total of living new-born. The figures vary depending on the geographical areas (Moldova and Muntenia having a higher prematurity rate). Besides the prematurity problem, the frequent occurrence of congenital heart malformations appears in this group of patients (3).
Congenital heart malformations in newborn babies with low birth weight

The pathology was dominant in the cardiovascular conditions diagnosed at a pediatric age in the Department of Pediatric Cardiology of „Sf. Maria” Clinical Hospital for Children of Iasi during 2011-2013, including only the group that had a low weight at birth, which resulted after anamnesis or hospital discharge note from neonatology department.

Upon analyzing the background environment, we notice a significant difference between urban and rural environment, control during pregnancy, early diagnosis of congenital heart disease and permanent monitoring being less often.

Different teratogens possible factors were tracked in 32 cases, representing 11.8% of the total CHM of the study group. Of the factors that intervened during pregnancy, we mention viral infectious factors (noticed in cases with DSA), chronic medication during some metabolic and neurological diseases, chronic alcohol consumption (met in cases with PCA and Fallot tetralogy). Thus, prevention by limiting exposure in collectivities, forbidding toxic substances consumption and a careful monitoring of the chronic diseases during pregnancy is very important (5, 11).

Most of the children included in the study, at birth were grade I (43%) premature, followed by dismature (25%) and a clinical state with APGAR score of 6-8 (80% of the cases) which demonstrates that the baby’s sufferance is obvious since birth.

The analysis of the distribution on sexes shows a slight increase of the male children (55.71%) compared to female ones (44.29%).

Regarding the frequency of the different types of CHM in new-born with a low weight at birth; we recorded an elevated percentage of the atrial septal defect (43.10%) and a smaller percentage for patent ductus arteriosus (23.28%), which has the highest frequency in literature (2).

Dominant symptomatology was intense or moderated cyanosis with onset immediately after birth and/or decompensation of cardias globals with tachycardia, tachypnea, breathing in circulation, pulmonary rales, hepatomegaly. The weight deficit is an alarm sign suspecting congenital heart malformations: within non-cyanogenic congenital heart malformations, this one occupies 60% of the cases while in cyanogenic cardiac heart diseases the frequency is much more elevated (86%) (9).

Diagnose sensibility of the echocardiographical investigation in the studied cardiovascular malformations was much higher than electrocardiography and X-ray, but the results of the echocardiographical exam were interpreted only in the clinical and anamnesical context and in correlation with the results of EKG exam and X-ray (7).

The most frequent complications were the recurrent respiratory infections, heart failure, pulmonary hypertension and endocarditis (complication of ventricular septal defect in 2 cases, of patent ductus arteriosus - 1 case, atrioventricular canal defect - 1 case) (10, 12, 13).

Chromosomal malformations associated to congenital heart malformations have a different distribution compared to those mentioned in literature: ostium secundum atrial septal defects is associated with malformations of conjunctive tissue: Marfan and Ehlers Danles, aortic stenosis associated with Turner syndrome, Fallot tetralogy is frequently associated with Di George syndrome, atrioventricular canal defect with ADPKD. Hence, the genetic consultation during pregnancy is always indicated and very important in quantifying the postnatal risks (4, 6).

The death occurred in a number of 24
(8.8%) children; 8 (2.6%) of them having genetic syndromes, 12 (4%) being linked to pulmonary association and respiratory infections. The mortality of the cases was at maximum in the first year of life and none was operated (8).

CONCLUSIONS

In our study new-born patients with low weight at birth, diagnosed with CHM, represents an elevated percentage 44.13% of the total of hospitalized cases for cardiovascular diseases in the Department of Pediatric Cardiology of “Sf. Maria” Clinical Hospital for Children of Iasi, with a slight predominance of the males and of Grade I premature patients.

Under structural aspect, the cardiovascular malformations, analyzed in the descending order of the frequency, were: atrial septal defects, patent ductus arteriosus, ventricular septal defects, pulmonary valve stenosis, aortic stenosis, coarctation of the aorta, atrioventricular canal defects, tetralogy Fallot, transposition of great arteries, truncus arteriosus, sole functional ventricle.

Etiopathogenesis is pretty limited, but we have noticed the frequent association of Down syndrome with ostium secundum atrial septal defects and Edwards syndrome with ventricular septal defects, fact that leads to the increase of mortality of these cases.

REFERENCES