DORV IN FETUSES: HOW TO CONSULT FUTURE PARENTS AT A PRENATAL CARDIOLOGY CENTER? RETROSPECTIVE ANALYSIS OF 39 CASES

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Abstract

DORV [double outlet right ventricle] is defined as a defect in which the great vessels leave entirely or mostly from above the morphologically right ventricle. The proposed by us new prenatal classification of heart defects for the DORV defect including the division into isolated and coexisting with extracardiac defect, facilitates consultation and predicting prognosis for the fetus and newborn. Isolated DORV in fetuses is classified as a severe elective defect (expected cardiac intervention or surgery at 1 month of age) with a relatively good prognosis for newborns, regardless of the type of intracardiac anomalies (in our series of cases 100% survival). DORV in the fetus with coexisting extracardiac defects (ECM) regardless of type of anomaly had poor prognosis (in our study group 100% demise rate).

Key words: *congenital heart defect, CHD double outlet right ventricle, DORV, fetal echocardiography prenatal diagnosis*

BACKGROUND

DORV [double outlet right ventricle] is defined as a defect in which the great vessels leave entirely or mostly from above the morphologically right ventricle. [1,2,3]

Anatomical classification of the defect by Van Praagh [4] or Lev [5] used in pediatric cardiology is of little clinical utility for the youngest patients (fetuses) in the prenatal period.

Aim: Which data is essential for proper consultation of prospective parents and perinatologists in relation to the fetus with DORV?

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MATERIALS AND METHODS

This was retrospective analysis of the data from a single institution: the medical documentation of 39 gravidas and their fetuses with a diagnosis of DORV, among 632 patients with fetal heart defects from the Prenatal Cardiology Department of the Institute of Polish Mother's Memorial Hospital, in the years 2008-2011. The study group of 39 patients was divided into two groups:

Isolated heart defect (n = 19) "DORV";

Heart defect coexisting with extracardiac congenital malformation ECM (n = 20) "DORV + ECM". We retrospectively analyzed echocardiographic and digital documentation of registered examinations. The following data was analyzed and compared between groups: the reason for referral for echocardiography, gestational age at which the fetal abnormalities were detected, heart size, the presence of problems such as non-cardiac structural defects, the presence of extracardiac anomalies: dysmorphy (no nasal bone, hypoteloryzm, abnormal profile), amniotic fluid index, fetal size based on biometrics in relation to gestational age according to the LMP, sex of the fetus, fetal karyotype, day in which cardiac surgery was performed, demises.

Indications	Isolated DORV n=19	DORV + ECM n=20	P
Cardiac	19	18	0,49
Extracardiac	0	2	

Table 1. The reason for referral for investigation to the reference center, in the subgroup of fetuses with isolated double outlet right ventricle [DORV isolated] and fetuses with associated additional non-cardiac defect [DORV + ECM].

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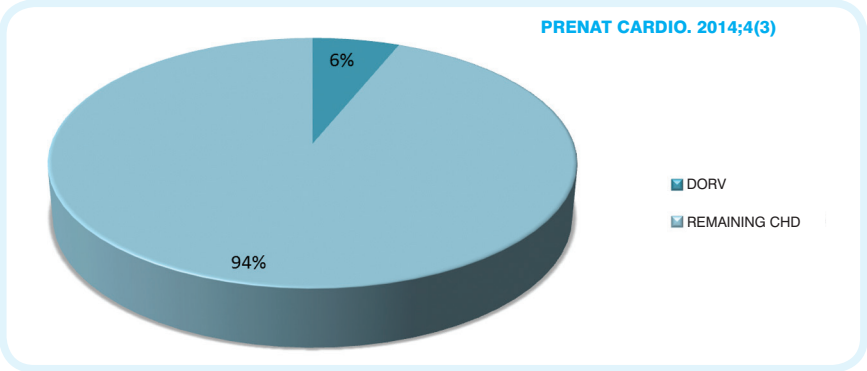

Figure 1. Percentage distribution of occurrence double outlet right ventricle [DORV] n = 39 in the group of all congenital heart disease [CHD] n = 632, in the material of the Department of Prenatal Cardiology ICZMP in the years 2008-2011.

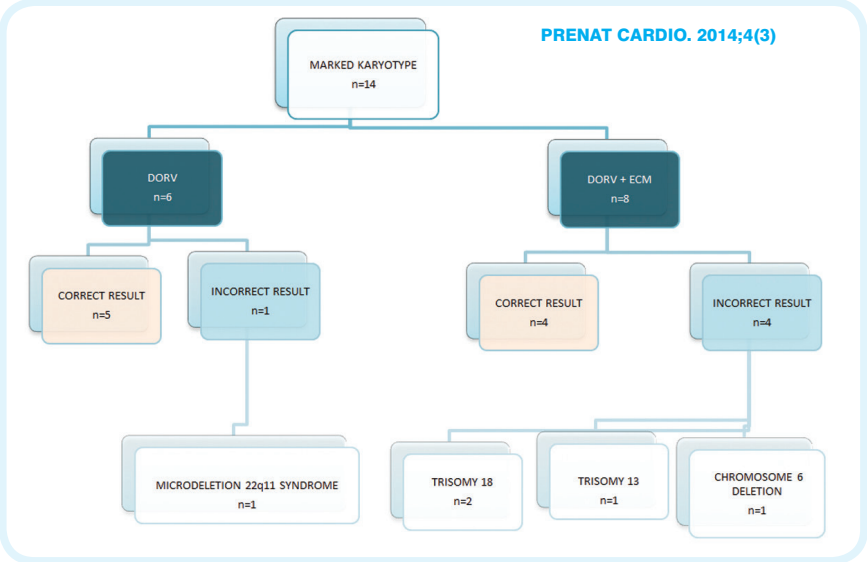

Figure 2. Analysis of labeled (n = 14) fetal karyotype in each group: DORV (n = 6) and DORV + ECM (n = 8).

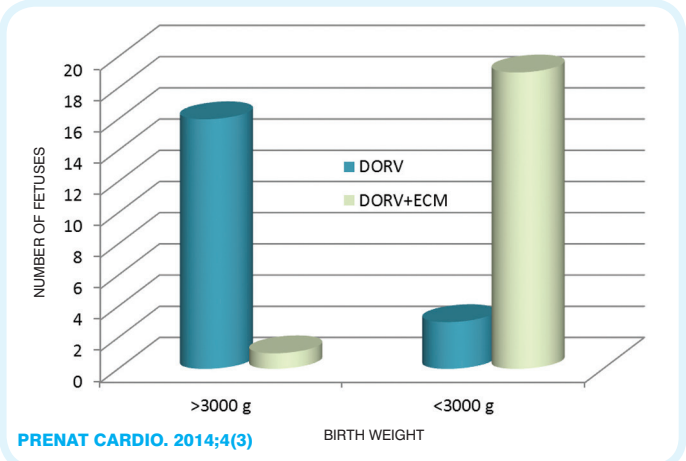

Figure. 3. Birth weight of newborns with DORV and DORV+ECM.

Examinations were performed using the ATL HDI 5000 ultrasound and Voluson 730 Expert Pro equipped with ultrasound probe heads of 5MHz frequency, 7.5 MHz and 9MHz. Digital recordings of examinations were collected in the MedArchive and 4Dview. The selection of studies were derived from the Department database. Statistical comparison was performed using the chi-square test of independence and Fisher's exact test, assuming the significance level of $P < 0.05$.

RESULTS:

Number of selected fetuses with DORV [39/632] accounted for 6% of all CHD examined in 2008-2011 (Figure 1) in the Department of Prenatal Cardiology at the Institute of Polish Mother's Memorial Hospital. Summary of comparative data are presented in Table 1.

Predominantly the indication to perform echocardiography in the referral center was suspected heart defects in the obstetric screening ultrasound: 19/19 cases in the DORV subgroup and 18/20 in DORV + ECM subgroup. In two cases, no heart defect was noted upon screening: in one case with extreme oligohydramnios in the other oligohydramnios and hiperechogenic bowel.

There were no significant statistical differences between the two subgroups in regard to: mean age of gravida, mean age of the fetus at the time of diagnosis and during diagnostic testing at the referral center, the gender of the fetus (Table 2) and in the evaluation of the karyotype (Figure 2).

There were no differences between DORV and DORV + ECM in the frequency of co-occurrence of additional intracardiac anomalies such as septal defect [VSD], transposition of the great arteries [TGA], pulmonary stenosis [PS], mitral atresia, common atrioventricular canal [AV canal], coarctation of the aorta [CoA], hypoplasia of the aortic arch [HAA], hypoplasia of the left ventricle, the total anomalous pulmonary venous return [TAPVR], partial anomalous pulmonary venous return [PAPVR], patent left superior vena cava [bilateral SVC].

There were also no significant statistical differences of functional anomalies (cardiomegaly, tricuspid regurgitation) between subgroups (Chart 1). Intrauterine growth restriction occurred in most parts [14/16] in fetuses with DORV + ECM (p=0,01) (Table 2).

Regarding the follow-up of fetuses and neonates, no significant statistical differences in the mean duration of pregnancy, the percentage of vaginal deliveries or Apgar score were noted. The majority of the 16/19 neonates from the DORV subgroup had a birth weight> 3000 g, and delivery in 18/19 cases took place> 37 weeks of gestation. In the DORV + ECM subgroup birth weight> 3000g occurred only 1 x (Figure 3).

			DORV, n=19	DORV+ECM, n=20	p
Demography	Mother's age	Mean	29,9	27,9	
		Mediana	31	29	
		Min.	18	17	
		Max.	40	35	
	Gestational age at which the fetal abnormalities were detected	Mediana	22,5	23	
		Min.	17	19	
		Max.	33,1	34	
	Gestational age at diagnostic testing at the referral center	Mean	29,2	28,2	
		Mediana	31	28,05	
		Min.	18,6	20,2	
		Max.	36,4	38,1	
	Sex	Male	12	7	0,4
		Female	6	10	0,55
Karyotype	Correct		5	4	1
	Incorrect	Microdeletion 22q11	1	0	
		Trisomy 13	0	1	
		Trisomy 18	0	2	
		Deletion of chromosome 6	0	1	
Congenital Heart Defect	Ventricular Septal Defect		18	17	1
	Transposition of the Great Arteries		18	12	0,46
	Pulmonary stenosis		6	6	1
	Mitral atresia		0	1	
	Atrioventricular canal defect		1	3	0,61
	Coarctation of the aorta		2	1	1
	Hypoplastic aortic arch		3	0	
	Hypoplastic left heart syndrome		1	1	1
	Total anomalous pulmonary venous return		1	0	
	Partial anomalous pulmonary venous return		0	1	
	Persistent left superior vena cava		0	1	
Functional changes	Cardiomegaly		2	9	0,09
	Tricuspid insufficiency		3	5	0,7
Extracardiac anomalies	Hyperechogenic bowel		2	4	0,66
	Hydronephrosis		1	7	0,11
	Single umbilical artery		1	5	0,2
	Cyst of umbilical cord		0	1	
	Incorrect volume of amniotic fluid	Oligohydramnios	2	5	0,42
		Anhydramnios	0	3	
		Polyhydramnios	2	6	0,26
		Summary	8	31	**0,01**
Intrauterine Growth Restriction			2	14	**0,01**
Dismorphia	Hypotelorism		0	4	
	Micrognathia		0	1	
	Low set ears		0	1	
	Hypoplastic nasal bone		0	1	
	Abnormal profil		0	2	
		Summary	0	9	
Extracardiac defects	Defects of the skeletal system	Hypoplastic chest	0	5	
		Club foot	0	2	
		Foot heel	0	1	
		Polydactyly	0	1	
		Absence of femur	0	2	
		Unspecified defect in hands and feet	0	3	
	Defects of central nervous system	Dandy-Walker syndrome	0	7	
		Hydrocephalus	0	4	
		Agenesis of the corpus callosum	0	2	
		Holoprosencephaly	0	1	
	Defects of urinary system	Multicystic dysplastic kidney	0	6	
		Renal agenesis	0	3	
		Agenesis of bladder	0	2	
		Megacystis	0	1	
	Craniofacial defects	Cleft lip and palate	0	3	
	Abdominal wall defects	Omphalocele	0	2	
	Defects of the spine	Spina bifida	0	2	
	Other	Spina bifida	0	4	
		Situs inversus	0	2	
		Summary	0	53	
	Week of gestation at the time of delivery	Mean	38,5	34	
		Mediana	39	37	
		Min.	36	20	
		Max.	40	42	
	Vaginal delivery		9	16	0,43
	Newborns with birth weight above 3000 g		16	1	**0,001**
	Number of points in the Apgar scale in the first minute of life	Mean	8,6	3	
		Mediana	9	1	
		Min.	5	0	
		Max.	10	9	
	Cardiac surgery in first month of life		16	1	**0,001**
		Demise	0	16	**0,0003**

All 16 neonates in the isolated DORV subgroup required cardiac surgery in the first month of life on average day 16 (Chart 2). In the DORV + ECM subgroup cardiac surgery was performed in only one case in a neonate with coexisting cleft upper lip and palate. Demise of the child occurred on day 100 of postnatal life.

The prognosis of fetuses with DORV is shown in Figure 4. In the subgroup with isolated DORV (n=16/19) and known follow-up, survival was noted in 100%. In DORV + ECM subgroup follow-up of fetuses was known in 16/20 cases, all of which proved fatal (Figure 4). The most of them died in the first week of age (n=10) , at the latest death in this group was noted in 104 days of life.

DISCUSSION

The incidence of the double outlet right ventricle according to various sources is 1-3% of all detected congenital heart malformations, which is an average of 1:10 000 live births. [7,8,9,15,16] According to the National Registry for Fetal Heart Pathologies in 2004-2013 the occurrence of DORV was 4.69% (www.orpkp.pl).

The formation of defects in the outflow tract is associated with impaired rotation of the primary outflow tract and its abnormal division, which conveys the wrong formation of the aorta and pulmonary trunk, and the relationship of the great arteries.[8,10,12,13,17,18,19,20,21,22]

In the literature we found several patterns of classification of DORV, where the common denominator is the departure of large vessels from the right ventricle. So far, DORV has been classified depending on the relationship of the great arteries and VSD. [8,11,14,23,24,25,26,27]

The existing structural divisions of heart defects, including DORV, are relevant to the strategic planning for the child, but they are scarcely useful before birth, especially in mid-pregnancy, or even before, when the

Table 2. Comparison of the tested subgroups (DORV n = 19 and DORV + ECM = 20), in the material of the Department of Prenatal Cardiology ICZMP in the years 2008-2011.

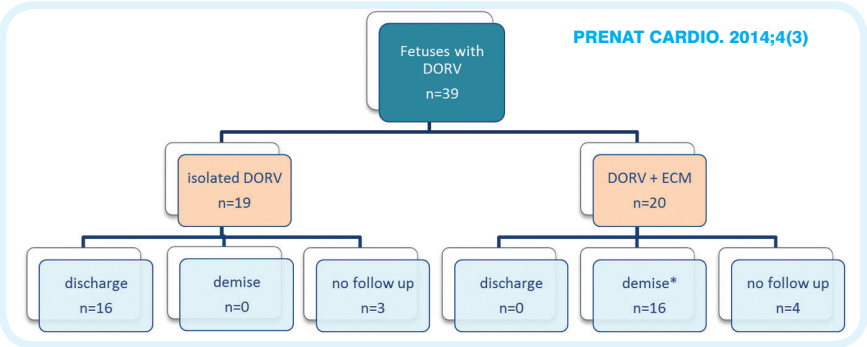

Figure 4. The number of cases in the analyzed material by reference to ending of pregnancy in the group with DORV (n = 16) and in the group with DORV and ECM (n=20) in the material of the Department of Prenatal Cardiology ICZMP through 2008-2011 period.
**including : intrauterine death (n = 2), termination of pregnancy (n = 3) death after delivery (n = 11)*

prospective parents and team of perinatologists would like to establish not merely the diagnosis for the patient but also prognosis. For this purpose, in our center we have developed a prenatal division of heart defects such as DORV into two groups depending on whether it is an isolated defect or concomitant with extracardiac defects. [6]

Comparing the frequency of coexisting additional intracardiac anomalies in the two subgroups DORV and DORV + ECM statistically significant differences were detected. These anomalies regarded the coexistence of VSD [89,7%], TGA [76,9%] and pulmonary stenosis [30,7%].

The most frequent concomitant extracardiac defects regarded the musculo-skeletal system [41%], central nervous system [35,7%] and urinary tract [30,7%]. In previous publications attention was drawn only to the type of accompanying defects and their prevalence. [19,28,30,31,32,33,34]

As resulted from our observation the type of extracardiac defects in fetuses with DORV had no effect on the survival of the newborn (in DORV + ECM subgroup 100% mortality in our series). Presumably, the very coexistence of extracardiac defects together with a heart malformation in the form of DORV is associated with severe prognosis not only for the fetus but the neonate as well. The neonate theoretically requiring two independent operations: cardiac and surgical, has very little chance of survival.

Another factor, whose role has not been evaluated in the available literature is the volume of amniotic fluid. A significant number [46%] of cases among our study subgroup (fetuses with DORV and abnormal amniotic fluid volume) had extracardiac anomalies, such as two-vessel umbilical cord, pyelectasis, umbilical cord cyst. Both polyhydramnios [75%], oligohydramnios [71%] and anhydramnios [100%] accompanied mainly fetuses with DORV and ECM (Table 2).

The neonates birth weight differed significantly (p=0,001) between DORV and DORV + ECM subgroups. In part this was due to a statistically significant higher prevalence of IUGR (p=0,01) in the subgroup of fetuses with DORV + ECM. In this subgroup in term newborns (birth> 37 tyg.ciąży) only in 1 case out of 20, birth weight was> 3000 g.

According to the prenatal classification of heart defects used in our center, DORV is regarded as a severe elective defect, i.e. meaning the necessity for cardiac surgery intervention in the first month of life. In the subgroup with isolated DORV 66.6% of interventions took place in the first two weeks of life, and 100% in the first month of life.

The presence of extracardiac malformations was the only factor significantly influencing the prognosis of the newborn. Neonatal survival was not affected by the type of coexisting VSD, nor was it affected by the way the vessels departed, or even the type of coexisting extracardiac malformation. In contrast, the very fact of its co-occurrence was significant. DORV + ECM subgroup comprised 100% mortality.

The proposed prenatal classification of heart defects for the DORV defect including the division into isolated and coexisting with extracardiac defect, facilitates consultation and predicting prognosis for the fetus and newborn.

The limitation of this work may be present small study group fetuses (n = 39), a small amount of labeled karyotypes (n = 14) and no long-term follow-up.

CONCLUSIONS

1.Isolated DORV classified as a severe elective defect

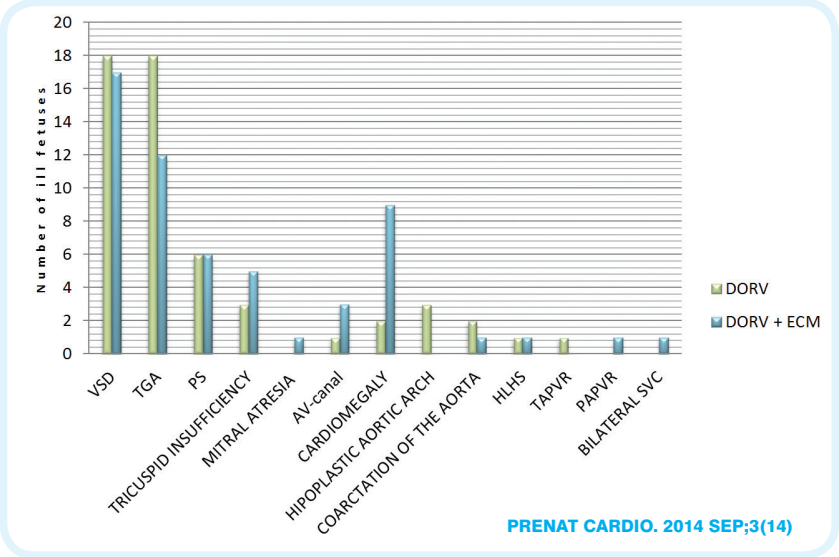

Chart 1. Coexisted cardiac anomalies with DORV and DORV+ECM in fetuses. Detailed description in the text. VSD- ventricular septal defect, TGA- transposition of the great arteries, PS- pulmonary stenosis, AV-canal- atrioventricular canal defect, TAPVR- total anomalous pulmonary venous return, PAPVR -partial anomalous pulmonary venous return, BILATERAL SVC- persistent left superior vena cava.

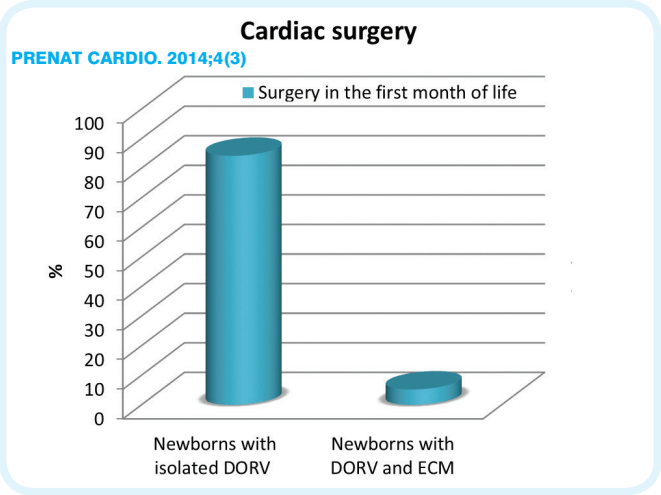

Chart 2. The percentage of neonates that underwent cardiac surgery in the first month of life, in two groups of newborns: the first group with DORV and the second group with DORV+ECM.

(expected cardiac intervention during the first month of postnatal life) had a relatively good prognosis for newborns, irrespective of the type of intracardiac anomalies (in our series of cases 100% survival).

2. DORV in the fetus with coexisting extracardiac defects (ECM) irrespective of type of anomaly had poor prognosis (in our study group 100% demise rate).

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