Original **paper**

FOLLOW-UP ON 107 FETUSES WITH NORMAL US + ECHO AFTER 37TH WEEK OF GESTATION

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Abstract

Introduction: Echocardiography of the fetal heart is an ultrasound examination that allows the evaluation of the anatomical structure and cardiovascular system usually performed in first half of pregnancy.

Material and methods: This work presents the data of 107 fetuses with normal heart anatomy (NHA) and normal heart study (NHS) and their neonatal follow-up. In this group (in an addition to routine prenatal work-up) has been performed also a echocardiography examination in the third trimester of pregnancy, after 37th week of gestation: 61% of pregnant women were referred to the prenatal cardiology center due to the presence of high-risk pregnancies and 39% were low-risk pregnancies.

Results: In two cases episodes of fetal arrhythmias were present during obstetrical examinations. After birth in the study group of 107 fetuses, 72% of newborns left the hospital during the 4 days and 28% newborns stayed in the hospital for longer time. In 16 cases their stay was extended due to maternal reasons and in 14 for newborns reasons.

Conclusions: 1) In the neonate group, after prenatal cardiac evaluation > the 37th week of gestation such as " normal fetal heart anatomy & normal heart study", all newborns in our center were born in good general condition. 2) Late prenatal echocardiography in 3rd trimester of pregnancy maybe considered as additional tool to prove fetal well being, specially in high risk pregnancies.

Key words: *normal fetal heart, 3rd trimester echocardiography*

INTRODUCTION

Prenatal diagnosis and its branch – fetal cardiology are fast growing areas in medicine. The heart of the fetus might be considered as a window of its world for specialists from the prenatal cardiology centers [1].

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The aim of the study was to analyze the neonatal period in 107 patients whose prenatal examinations performed in the third trimester of pregnancy in the reference center of prenatal cardiology, revealed normal heart anatomy (NHA) and normal heart study (NHS), (no abnormalities in function of the heart). The relation of the prenatal evaluation with postnatal clinical examination was assessed. It was analyzed how many days were hospitalized newborns with NHA + NHS after the birth and what were the reasons for their extended stay in the hospital.

MATERIAL AND METHODS

Initial analysis included 198 fetuses who underwent echocardiography at our center (Fetal Cardiology referral center) in years 2015 and 2016. Participation in the research was determined by US + ECHO after 37th week of gestation, in an addition to routine perinatal care. Normal biometry in agreement with gestational age based on last menstrual period (maximal difference up to 7 days), normal AFI, normal Doppler tracing in umbilical artery and vein, normal middle cerebral artery and ductus venosus flow and normal heart anatomy + normal heart study + no extracardiac anomalies + and follow up of the neonate born in our institution.

The exclusion criteria were: gestational age below 37 weeks, abnormal heart anatomy, abnormal function of the fetal heart (based on M-mode or Tei index for LV and RV or both, based on colored Doppler on intracardiac flow at the level of foramen ovale, ductus arteriosus, aortic arch and isthmus, pulmonary veins Doppler tracing at the level of left atrium), any extracardiac structural malformations and extracardiac anomalies (for instance 2 vessels cord, polyhydramnion or oligohydramnion or placentitis > 5 cm thickness), childbirth outside of our Institute. The data were retrospectively collected from the data base of our unit. Final analysis was performed on 107 fetuses (91 cases

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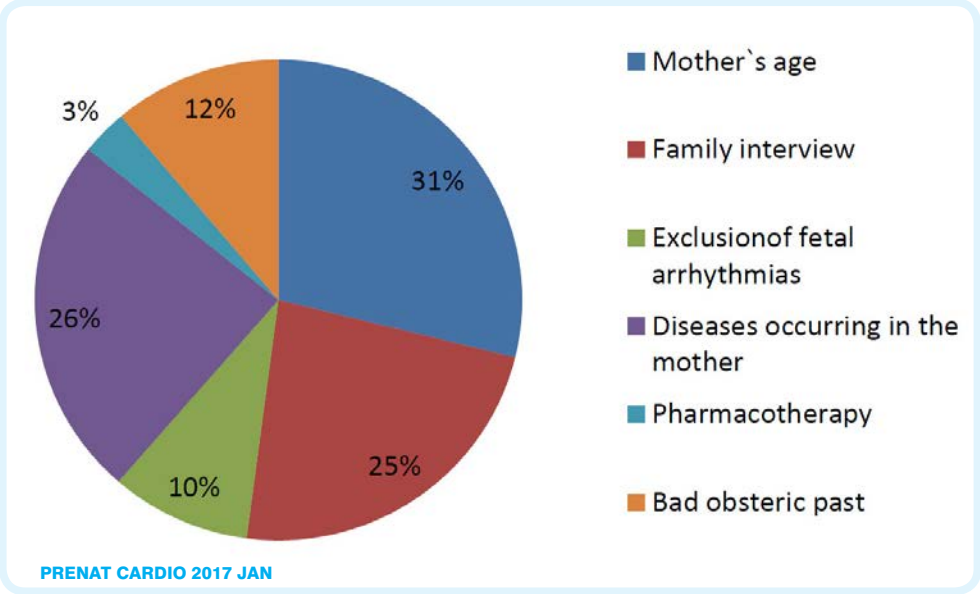

Fig. 1. Indications for prenatal cardiac examination in high-risk pregnancies in our series.

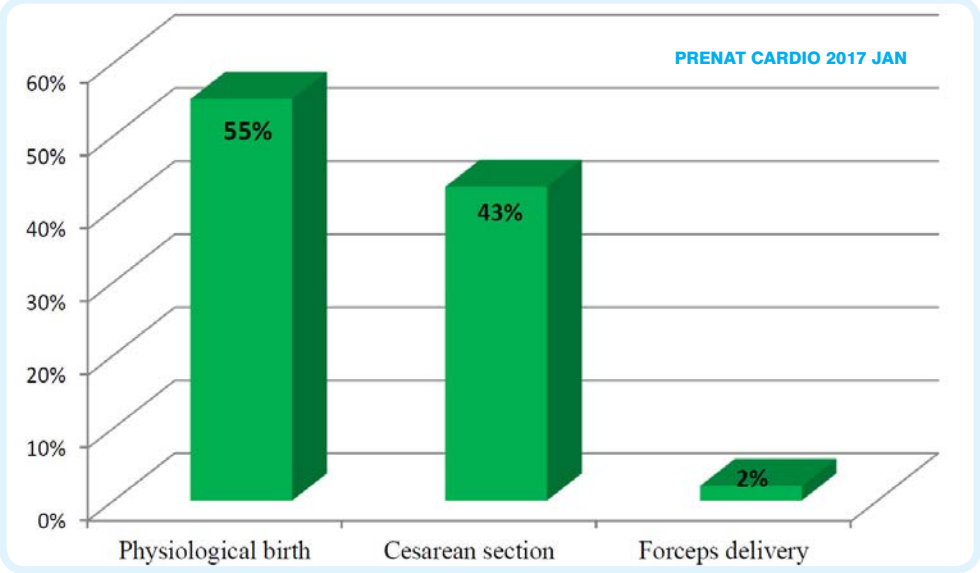

Fig. 2. Types of births in this material n=107 (100%)

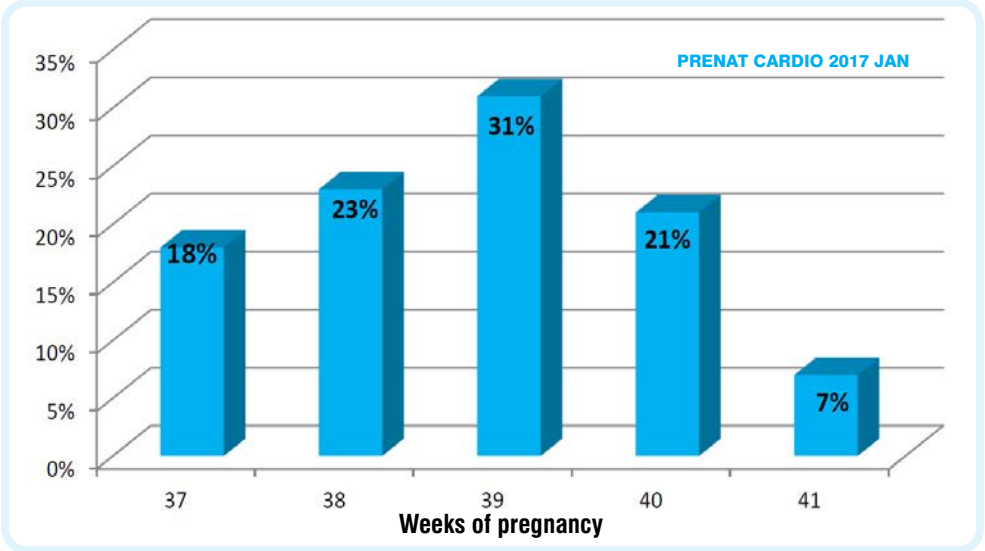

Fig. 3. Neonatal population at birth and completed weeks of pregnancy

were excluded due to lack of follow-up of newborns - births outside of our Institute).

The analysis included: age of the pregnant woman, gestational age according to the date of the last menstrual period, fetal biometric age, expected date of childbirth, indications for referral for fetal echocardiography, cardiac anatomy, cardiovascular profile score (CVPS) , Apgar score, birth weight, sex, number of days spent in hospital for home discharge.

RESULTS

In the analyzed group high-risk pregnancies were predominant - 64%. In high-risk pregnancies major indication for fetal echocardiography were: maternal diseases - 21 cases (31%), the advanced maternal age > 35 years - 17 (25%), positive family history for congenital heart defects 13 (19%), obstetrical history - 8 cases (12%), fetal heart arrhythmias - 7 (10%) and maternal pharmacological treatment - 2 (3%) (Fig. 1).

The majority of newborns (n = 59) were born by nature, 46 newborns were born by caesarean section. Forceps were used 2 x (Fig. 2).

In the studied group the highest number of newborns was born at the 39th week of gestation, (31%). Pregnancies were completed on an average of 38.7 weeks of gestation (Figure 3).

53% of fetuses had 10 points on the Apgar scale in the first minute after delivery, 31% had 9 points and 16% of the newborn – 8 points. None of the newborns received < 8 points in Apgar score. The average Apgar score was 9.4 (Fig.4).

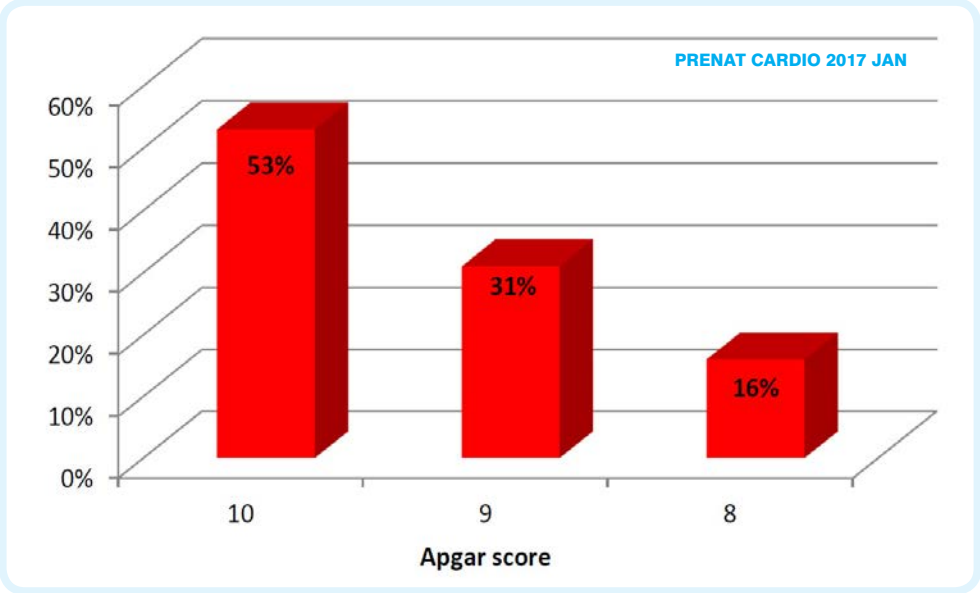

Fig. 4. Apgar score in 107 newborns

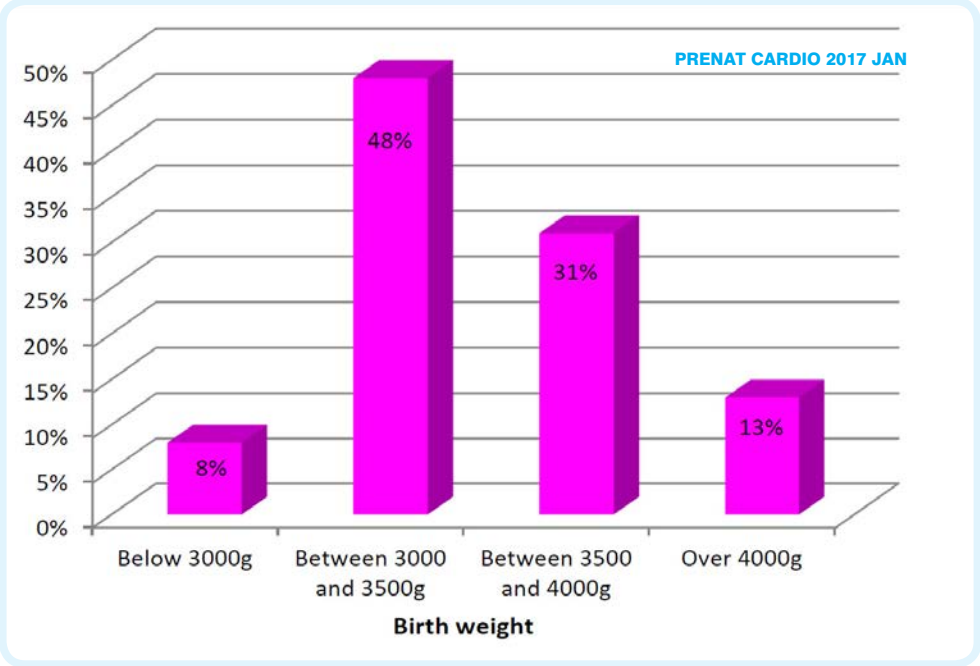

Fig. 5. Neonatal birth weight of n = 107 cases.

Maternal causes	Number of newborns
Chronic maternal diseases*	6
Postnatal complications	5
Maternal, perinatal infections	5

**3 x diabetes mellitus, 1 x depression, 2 x hyperthyroidism*

Table 1. Maternal causes of prolonged stay of the newborn in the hospital

There were 56% girls and 44% boys. Forty eight % of newborns had a birth weight of 3000-3500g, 31% were had birth weight 3500 - 4000g, and 13% of newborns had >4000g. Eight % had neonatal weight of <3000g. The average birth weight of newborns was 3449g (Fig. 5).

Fifty three % of newborns were discharged from the hospital on the 3rd day, 17% on the 4th day, 10% on the 5th day, 7% on the 6th day, 5% on the 7th day, on days 8th, 9th and 10th, 2% of newborns and next 2% > ten days of hospitalization (Fig. 6).

Seventy % of newborns were discharged home on 3rd and 4th day after delivery and 30% were hospitalized longer.

Extended hospital stay was divided into two groups - maternal n=16 (53,3%) and neonatal n=14 reasons (46,7%). "Maternal" causes included 6 x chronic maternal diseases (37.5%), 5 x postpartum complications (31.25%), in 2 cases these were complications after a forceps delivery. This group included also 5 x perinatal maternal infection (31.25%) (Table 1).

The second group of the extended hospital stay (> 4 days) were newborns complications: 5x physiological jaundice (35.8%), 6x neonatal prolonged ECG monitoring in cases of history of fetal arrhythmia (42.8%) and 3x other causes (21.4%), (neonatal infection, neonatal hypotrophy and macrosomia).

Six newborns were hospitalized longer due to maternal reasons (Figure 9).

Table 3. Comparison of prenatal with postnatal diagnoses in the analyzed group (n = 107).

For 107 births there were no structural defects, no chromosomal aberrations, no false-positive and false-negative results.

DISCUSSION

So far, normal fetal cardiac anatomy was the main target of interest at the early stage of prenatal cardiology introduced by Allan in early 80ties[2]. In 90ties we had accepted that the best time to look at the fetal heart and confirm its normal anatomy or detect congenital heart defect is at the 18th weeks [3,4]. Later on, with the

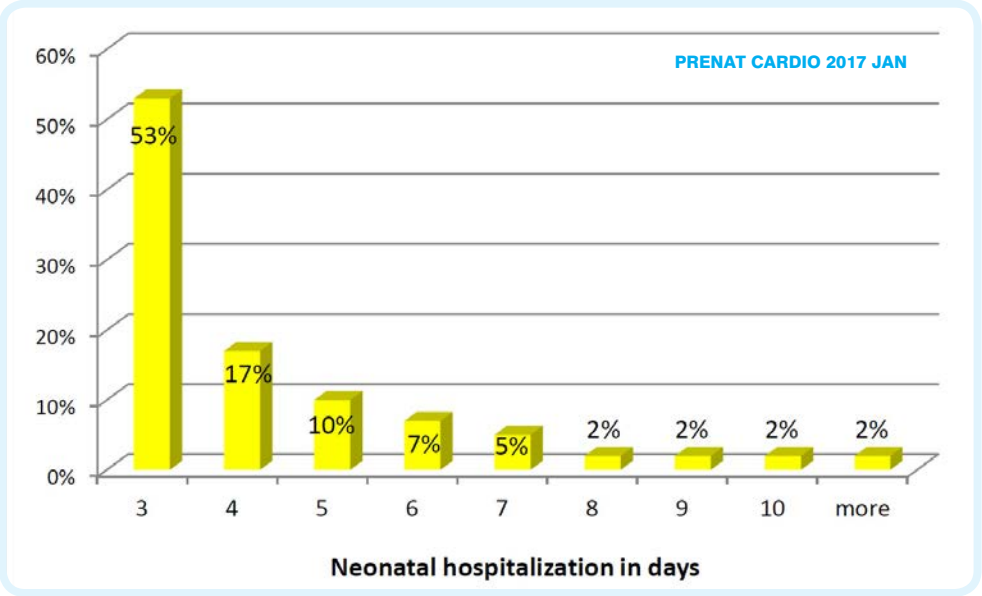

Figure 6. The number of days of hospitalization of newborns, who as a fetuses > 37th week of gestation had Normal Heart Anatomy and Normal Heart Study.

progress in ultrasound technology, our point of interest was focused on 1st trimester[5,-7]. Than, there was debate in scientific literature, when is on optimal time for detailed fetal anatomic scanning: and should it done transvaginally or transabdominally, in the late first trimester versus early second trimester of pregnancy[8,9]. Normal fetal echocardiography was considered as base for measurements and normograms[10,11].

There were just a few papers focusing on the functional abnormalities in normal heart anatomy, such as: tricuspid valve regurgitation and pulmonary regurgitation.[12-14].

Our team was one of the very first who noticed than functional fetal heart abnormalities might be temporary and good indicator of an improvement of the fetus condition also in extracardiac malformation[15,16].

Neonatal reasons	Number of newborns
Physiological jaundice / phototherapy	5
ECG monitoring of the newborn due to episode of fetal arrhythmia	6
Other	3

Table 2. Newborns complications and prolonged hospital stay after birth (> 4 days).

Diagnosis	The number of diagnoses
Match	107
Mismatch	0
False-positive result	0
False-negative result	0

Table 3. Comparison of prenatal with postnatal diagnoses in the analyzed group (n = 107).

It was proofed that fetal echocardiography monitoring is recommended in congenital heart diseases because of evolution some malformations during pregnancy, especially in third trimester of the pregnancy[16-21].

In this study, 107 fetuses with normal heart anatomy (NHA) and normal heart study (NHS) were analyzed. A prenatal examination was conducted in the third trimester, in an addition to the routine perinatal care, after the 37th week of pregnancy, between 2015 and 2016. High-risk pregnancies were predominant in the study population, due to family history, maternal age, chronic maternal disease or poor obstetric history (Fig. 1). Similar indications were given in other centers of prenatal cardiology[22]. Other indications are suspicions of the congenital defect on the basis of the screening US examination. Twenty eight % of fetuses were referred for a prenatal cardiologic examination in our center due to episodes of arrhythmia.

Over half of newborns (55%) in the study group were born by vaginal delivery (Fig. 2).

(Table 1), at average 38,7 week of gestation, mean birth weight was 3449g average Apgar score was 9,4, and 70 % of newborns were discharged from hospital on the third and fourth day . Thirty % of newborns required longer hospital stay. Prolonged hospitalization of neonates in 53.3% resulted from the maternal causes.

Long-term hospitalization for neonatal causes was mainly due to either physiological jaundice (and their photo therapy) or neonatal monitoring following a prenatal arrhythmia. Prenatal cardiological diagnostics in the analyzed neonatal group (Normal Heart Anatomy) was confirmed after birth with no false positive or false negative results.

Our analysis regarding the value of late 3rd trimester echocardiography is one of the very few in the literature. So far majority of reports have focused on either screening for fetal circulatory system abnormalities or on diagnostic examination mostly in the 1st half of pregnancy[3-9].

The purpose of our analysis was to draw attention to the value of echocardiography confirming fetal well-being by demonstrating the normal heart anatomy and normal heart study (no function abnormalities) of the heart in the third trimester after the 37th week of gestation.

Our hypothesis is that prenatal echocardiography in 3rd trimester or before delivery could be an additional valuable tool for the obstetricians not only for monitoring but also to confirm the fetal well being.

CONCLUSIONS

1) In the neonate group, after prenatal cardiac evaluation > the 37th week of gestation such as " normal fetal heart anatomy & normal heart study", all newborns in our center were born in good general condition.

2) Late prenatal echocardiography in 3rd trimester of pregnancy maybe considered as additional tool to prove fetal well being, specially in high risk pregnancies.

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Division of work:

Iwona Strzelecka: first draft of manuscript, literature search, submitting the manuscript

Eliza Michalska: work with data base, literature search

Katarzyna Zych-Krekora: English version, work with the manuscript,

Maria Respondek-Liberska: concept of the research, work with the manuscript, literature search, final version

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