Prenat Cardio 2019
DOI: https://doi.org/10.5114/pcard.2019.92544
Received: 9.12.2019
Accepted: 6.01.2020

Prenatal Cardiology
www.termedia.pl/Journal/Prenatal_Cardiology

Research paper

Fetal congenital heart disease and fetal position – are they related?

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Abstract

Ultrasound (US) is the principal imaging modality used to diagnose and evaluate congenital heart disease (CHD), which is the most common birth defect worldwide, affecting 9.410 per 1000 newborns. Mother's BMI, amniotic fluid index, and fetal mobility and position are factors that influence the precision and difficulty of prenatal US examination. In our study we considered whether fetuses with CHD have a predilection to any position. It has never been reported before. We analysed results of 1620 (control – 835, isolated CHD – 321, non-isolated CHD – 464) fetal cardiac US performed between June 2016 and September 2019 at the Department of Prenatal Cardiology. The following parameters: gestational age, fetal position, CHD, and non-cardiac anomalies/defects were taken into consideration for further statistical analysis. We observed a statistically higher frequency of right cephalic position (CII) among fetuses with CHD, as well as isolated and non-isolated CHD in comparison to healthy controls ($p < 0.0001$, $p < 0.0001$, and $p = 0.0015$, respectively; $n = 1620$). These findings may be an effect of more advanced gestational age of CHD patients. Hence, we performed further analysis in the age group ≥ 33 weeks of gestation, which also revealed statistically significant differences in the CII position in the group of CHD fetuses, especially isolated ones when compared to healthy controls ($p = 0.0292$ and $p = 0.0049$, respectively; $n = 674$). Fetuses with CHD had a predilection to right cephalic position more often than healthy fetuses. Because this factor determines the high-quality of US examination, it should be mentioned in medical reports of prenatal ultrasound.

Key words: congenital heart disease, fetal position, right cephalic position, prenatal cardiology, prenatal ultrasound diagnosis.

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Introduction

Ultrasound (US) is the principal imaging modality used to diagnose and evaluate congenital heart disease (CHD) – the most common birth defect, affecting 9.410/1000 newborns [1]. Infants born with CHD may require emergent treatment in the newborn period to improve their survival [2]. Early detection depends on the body mass index of the mother, amniotic fluid index, and fetal mobility and position because these factors affect the precision and difficulty of US [3, 4]. During the third trimester of gestation the majority of fetuses assume a cephalic position (left – CI or right – CII cephalic position) [5]. Right cephalic position means that the head is down and the fetal spine lies on the maternal left, as presented by the drawings in the tables. In certain fetal positions US examination of the fetal heart is easier [6].

The path of US waves among fetuses lying in the CII position is shorter and crosses fewer anatomical structures to reach the fetal heart, which can increase the quality of fetal US heart examination. In our study we examined whether fetuses with CHD have any predilection to left or right cephalic positions.

Material and methods

We analysed results of 1620 (control – 835, isolated CHD – 321, non-isolated CHD – 464) fetal cardiac US performed between June 2016 and September 2019 at the Department of Prenatal Cardiology. We took into the consideration the last US examination. Only singleton fetuses older than 20 weeks of gestation, which were healthy or with CHD (isolated and non-isolated), were enrolled in the study. The following parameters: gestational age, fetal position (CI, CII; breech position – B, transverse position – T, oblique position – O), CHD, and noncardiac anomalies/defects were taken into consideration for further statistical analysis. The following tests were used to assess the differences in frequency of given fetal positions variation between congenital heart disease (non-isolated, isolated ones, and overall) and healthy: χ^2 test, Yates-corrected χ^2 statistic, and Fisher's test. Tests were used according to the smallest group number: $15 \leq n$, $5 \leq n < 14$, and $n < 5$, respectively (Statistica 13.1 PL).

Results

Healthy fetuses (average gestational age: 28.9 ±4.7 weeks; range: 20–39.9 weeks) revealed 41% of CI, 29% of CII, 18% of B, 10% of T, and 2% of O. In the case of isolated CHD (32.9 ±4.6; range: 20–41.4) these frequencies were equal to 40% of CI, 43% of CII, 10% of B, 6% of T, and 1% of O. And in the case of non-isolated CHD (33.2 ±4.5; range: 20–39.6): 45% of CI, 38% of CII, 13% of B, 3% of T, and 1% of O. A statistically higher frequency of CII position among fetuses with CHD, both isolated and non-isolated, in comparison to healthy control was observed ($p < 0.0001$, $p < 0.0001$, and $p = 0.0015$, respectively; $n = 1620$; Table 1). These findings may be an effect of more advanced gestational age of CHD patients. Therefore, we performed further analysis in age groups: ≤ 26, 27–32, and ≥ 33 weeks of gestation, which revealed statistically significant differences in CII position among the ≥ 33 weeks of gestation group of CHD fetuses, especially isolated ones, when compared to healthy controls ($p = 0.0292$ and $p = 0.0049$, respectively; $n = 674$; Table 2). For the ≤ 33 weeks of gestation group the average gestational age of the control group, isolated and non-isolated CHD, were: 35.1 ±1.6 (range: 33–39.9), 36.1 ±1.8 (range: 33–41.4), and 35.9 ±1.8 (range: 33–39.6), respectively.

Discussion

Multiple independent studies evaluating the effect of fetal position on labour outcome and duration were conducted [7–9]. The number of studies assessing the influence of fetal position on prenatal US diagnosis is much smaller. To the best of our knowledge, the influence of fetal position on fetal US examination was assessed only for the following parameters:

Table 1. The frequency of each foetal position among fetuses with congenital heart disease (non-isolated, isolated, and overall) as well as healthy controls

Fetal position		Congenital heart disease			Healthy control	*p*-value		
		Non-isolated	Isolated	Overall		Non-isolated	Isolated	Overal
CI		209 (45%)	129 (40%)	338 (43%)	341 (41%)	0.1417*	0.8400*	0.3657*
CII		176 (38%)	138 (43%)	314 (40%)	245 (29%)	**0.0015***	**< 0.0001***	**< 0.0001***
BI		36 (8%)	17 (5%)	53 (7%)	66 (8%)	0.9255*	0.1239*	0.3742*
BII		23 (5%)	15 (5%)	38 (5%)	86 (10%)	**0.0009***	**0.0024***	**< 0.0001***
T		13 (3%)	18 (6%)	31 (4%)	80 (10%)	**< 0.0001****	**0.0299***	**< 0.0001***
O		3 (1%)	2 (1%)	5 (1%)	13 (2%)	***	***	**
Others		4 (1%)	2 (1%)	6 (1%)	4 (0%)	***	***	**

*CI – left cephalic position, CII – right cephalic position, BI – left breech position, BII – left breech position, T – transvers position, O – oblique position; *χ^2, **Yates's corrected χ^2, ***Fisher's exact test.*

Table 2. The frequency of each fetal positions among fetuses older than 33 weeks of gestation with congenital heart disease (non-isolated, isolated ones, and overall) as well as healthy controls

Fetal position		Congenital heart disease			Healthy control	*p*-value		
		Non-isolated	Isolated	Overall		Non-isolated	Isolated	Overall
CI		145 (48%)	82 (44%)	227 (47%)	100 (53%)	0.2696*	0.0626*	0.1104*
CII		129 (43%)	96 (51%)	225 (46%)	69 (37%)	0.1825*	**0.0049***	**0.0292***
BI		9 (3%)	5 (3%)	14 (3%)	6 (3%)	0.8886**	1.0000**	0.9802**
BII		10 (3%)	3 (2%)	13 (3%)	6 (3%)	0.8523**	0.5025***	0.9055**
T		4 (1%)	1 (1%)	5 (1%)	6 (3%)	0.1934***	0.1215***	**
O		2 (1%)	0 (0%)	2 (0%)	0 (0%)	0.5259***	***	***
Others		1 (0%)	0 (0%)	1 (0%)	0 (0%)	1.0000***	***	***

*CI – left cephalic position, CII – right cephalic position, BI – left breech position, BII – left breech position, T – transvers position, O – oblique position; *χ^2, **Yates's corrected χ^2, ***Fisher's exact test.*

nuchal translucency thickness, amniotic fluid index, and single deepest pocket. Fetal position had no significant influence on the measurement of nuchal translucency and single deepest pocket [10, 11]. In the case of amniotic fluid index, fetal position significantly affected the measurements of this parameter [11].

In the 20th week of gestation only 45% of fetuses assumes the cephalic position, in comparison to the 33rd week of gestation when that percentage rises to 92% [5]. For that reason, analysis of fetal position after 33 weeks of gestation is more significant in this case. The average time to obtain the main US cardiac views is just over 2 min, but in approximately one third of cases, the cardiac US examination can be postponed by 15–20 min due to unfavourable fetal position [6]. In our study, fetuses with CHD had a predilection to lie in the right cephalic position, which is more favourable for US examination. This is one of the factors that facilitates US examination and CHD diagnosis. About 50–60% of patients with diagnosed CHD will require surgical correction to survive or to reduce disabilities in future [2]. A highly sensitive and easy examination is crucial to identify all the fetuses requiring surgical treatment.

Despite the fact that advanced gestational age and cephalic position makes US examination easier [12], in some cases decreased amniotic fluid and increased acoustic shadow of the fetal spine can interfere with the quality of US examination [13, 14]. Therefore, awareness of the position of the fetal spine is important for the proper interpretation of US images. Even though ISUOG Practice Guidelines do not recommend the obligatory use of fetal body position pictograms from the ultrasound machines, we would strongly recommend it because our research has shown its potentially great value [6].

Conclusions

Fetuses with CHD had a predilection for the right cephalic position more often than healthy fetuses. It has never been reported before. Because this factor determines the high-quality of US examination, it should be mentioned in medical reports of prenatal ultrasound.

Acknowledgements

The authors would like to thank the physicians working at Department of Prenatal Cardiology, Polish Mother's Memorial Hospital in Lodz ; this article could not be written without the data obtained during examinations performed by them.

Conflict of interest

The authors declare no conflict of interest.

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