



Fetal Echocardiography Characteristics in a Tertiary Center

Elif Erolu ^{ID}, Özlem Sarisoy ^{ID}

ABSTRACT

Objective: Fetal echocardiography is an important and growing diagnostic tool for early detection of congenital heart diseases and rhythm problems. In this study, we evaluated retrospectively indications and prenatal and postnatal diagnoses for fetal echocardiography.

Materials and Methods: Prenatal and postnatal echocardiographic diagnoses of the newborns and data of pregnant women who were referred to the Pediatric Cardiology Clinic of Ümraniye Training and Research Hospital between October 2018 and October 2019 and newborns were obtained from medical recordings.

Results: In this study, 138 patients were included. Eighty-one (58%) indication was suspected congenital heart disease, twenty-four indications (13%) was screening test positivity, 10 hyperechogenic focus, two advanced age pregnancy, six diabetes mellitus. Two were hydrops fetalis (immune/nonimmune), five dysrhythmias, one fetal anomaly. Hereditary causes were congenital heart disease in seven previous pregnancies. Sixty-eight patients with normal fetal echocardiography were normal in the postnatal period. Diagnosis of cyanotic congenital heart diseases was 24.2% of all patients, and 47.1% were acyanotic congenital heart disease in our study population. Four of the patients had arcus aorta anomalies. One patient had sustained supraventricular tachycardia with hydrops fetalis resolved with sotalol and digoxin treatment. One patient had neonatal thyrotoxicosis because of maternal graves disease

Conclusion: Fetal echocardiography is a useful and noninvasive method for early diagnosis and treatment, especially in rhythm problems. Also, diagnosis of congenital heart diseases antenatally is useful for planning the management of the disease.

Keywords: Fetal echocardiography, congenital heart disease, rhythm problems

Cite this article as:
Erolu E, Sarisoy Ö.
Fetal Echocardiography
Characteristics in a
Tertiary Center. Erciyes
Med J 2020; 42(2): 143-6.

INTRODUCTION

Fetal echocardiography is a diagnostic method that investigates cardiac anatomy function and rhythm during the antenatal period. It helps to detect the antenatal congenital heart diseases and rhythm problems. Congenital heart disease is seen in 0.8% to 1.2% of live births (1). Diagnosis of congenital heart disease in antenatal period increases the chances of survival of babies as CHD becomes complex. The presence of antenatal diagnosis was found to be one of the factors decreasing mortality, especially in patients with hypoplastic left heart (2). The presence of antenatal diagnosis is effective in decreasing mortality/morbidity after birth and is an important diagnostic tool in the decision to terminate the pregnancy.

In this study, we retrospectively compared the reasons for referring to fetal echocardiography in pregnant women who were referred for fetal echocardiography and the diagnoses during antenatal and postnatal periods.

MATERIALS and METHODS

In our study, the data of pregnant women who were referred to the Pediatric Cardiology Clinic of Ümraniye Training and Research Hospital between October 2018 and October 2019 were evaluated retrospectively. Data of gravid, parity, abortion, stillbirth, drug use, diabetes mellitus, presence of hypertension, history of congenital heart disease in mother or brother, and presence of IVF pregnancy were obtained from medical recordings.

Postnatal echocardiography controls of newborns were made. The patients who did not come to echocardiography control postnatally were reached by telephone and invited for control. Information about newborns who had delivered and operated in another hospital was obtained from the echocardiography reports or operation notes. Newborns and pregnant women whose information could not be reached were excluded from this study. Echocardiographic diagnoses of the newborns and birth weight and birth week were recorded. The presence of physiological PPS and PFO in newborns was not considered as congenital heart disease.

Division of Pediatric
Cardiology, Department of
Pediatrics, Istanbul Health
Sciences University, Ümraniye
Training and Research
Hospital, Istanbul, Turkey

Submitted
06.01.2020

Accepted
20.02.2020

Available Online Date
20.03.2020

Correspondence

Elif Erolu,

Division of Pediatric
Cardiology, Department of
Pediatrics, Istanbul Health
Sciences University, Ümraniye
Training and Research
Hospital, Istanbul, Turkey
Phone: +90 216 632 18 18-
4783
e-mail: eliferolu@yahoo.com

©Copyright 2020 by Erciyes
University Faculty of Medicine -
Available online at
www.erciyesmedj.com

Table 1. Maternal demographic features

| | n |
|--|-------------------|
| Age (years) | 29.5±5.5 |
| Mean gestation week | 24.2±5.2 |
| Nulliparous/Multiparous (n, %) | 64 (46%)/74 (54%) |
| Gestational age at delivery (week) | 38.2±1.15 |
| Fetal echocardiography indications | |
| Maternal causes | |
| Screening test positivity | 24 |
| Suspicion of Congenital heart disease | 81 |
| Echogenic intracardiac focus | 10 |
| Advanced age pregnancy | 2 |
| Diabetes mellitus | 6 |
| Fetal causes | |
| Immune/nonimmune hydrops | 2 |
| Rhythm problems | 5 |
| Fetal anomaly | 1 |
| Hereditary causes | |
| Previous sibling with congenital heart disease | 7 |

Fetal echocardiography was performed by two pediatric cardiologists. Philips Affiniti 50C Echocardiography device (Release 2.0.1 Philips Healthcare 3000 Minuteman Road Andover, MA 01810 USA) and convex probe were used for fetal echocardiography. 2D Echocardiography, M-mode, Pulsed Wave Doppler Echocardiography were used for fetal diagnosis. SPSS 22 software package (IBM Corp., Armonk, NY, USA) was used for statistical analysis. Descriptive statistical methods were used. Patients gave written consent for this study, and this study was approved by the local ethics committee at Istanbul University of Health Sciences Umraniye Training and Research Hospital on 06.25.2018 (protocol number 25.09.2019.19527).

RESULTS

Maternal Demographics

In this study, 138 patients out of 190 patients admitted to our out-patient clinic for fetal echocardiography between October 2018 and October 2019 were included. The mean age of the pregnant women was 29.5±5.5 years.

Maternal and Fetal Clinical Features

Sixty-four pregnant women (46%) were nulliparous and 74 pregnant women were multiparous (54%). Nine patients had a family history of congenital heart disease. One of the pregnant women lost her previous baby due to congenital heart disease postnatally. Eighty-eight pregnant women were under 24th weeks of gestation during fetal echocardiography, 50 patients were over 24th weeks of gestation. The smallest gestational week was 17 and the highest gestational week was 36. Six pregnant women had diabetes mellitus; three were diagnosed with DM before pregnancy and using insulin and three had gestational diabetes mellitus. One patient had hypertension. Three mothers had obesity. Amniocentesis was per-

Table 2. Prenatal and postnatal echocardiographic diagnosis

| | Prenatal | Postnatal |
|--|----------|-----------|
| Normal | 68 | 102 |
| VSD (small) | 17 | 4 |
| VSD (medium- large) | 8 | 6 |
| AVSD | 3 | 2 |
| Partial AVSD | 2 | 1 |
| Fallot tetralogy | 4 | 3 |
| VSD+Pulmonary atresia | 1 | 2 |
| DORV | 2 | 3 |
| DORV+AVSD | 1 | 1 |
| DILV, VA discordance, aortic hypoplasia, BVF | 1 | 1 |
| Arcus hypoplasia | 2 | 1 |
| Aortic coarctation | 1 | 0 |
| Right arcus aorta | 1 | 1 |
| Tricuspid atresia | 4 | 4 |
| TGA+VSD+ tricuspid atresia | 1 | 1 |
| Pulmonary stenosis (valvular) | 1 | 1 |
| HLHS | 2 | 2 |
| Sinus tachycardia | 1 | 1 |
| Non-conducting atrial beats | 1 | 0 |
| Supraventricular tachycardia | 1 | 0 |
| Tricuspid insufficiency | 4 | 1 |
| Pericardial effusion | 1 | 0 |
| Hyperechogenic focus | 11 | 1 |

VSD: Ventricular septal defect; AVSD: Atrioventricular septal defect; DORV: Double outlet right ventricle; DILV: Double inlet left ventricle; VA discordance: Ventriculoarterial discordance; BVF: Bulboventricular foramen; TGA: Transposition of great arteries; HLHS: Hypoplastic left heart syndrome

formed for three women and Down syndrome was detected in one of the three fetuses. One patient was using levothyrox and one patient was using alfamed. Demographic maternal and neonatal features were shown in Table 1.

Indications for Fetal Echocardiography

The indications for fetal echocardiography were divided into three main groups. Maternal causes were 24 (13%) screening test positivity, 81 (58%) suspected congenital heart disease, 10 hyperechogenic focus, two advanced age pregnancy, six diabetes mellitus. Fetal causes were two hydrops (immune/nonimmune), five dysrhythmia, one fetal anomaly. Hereditary causes: Congenital heart disease in seven previous pregnancies (Table 1).

Comparison of Prenatal and Postnatal Diagnoses and Prognosis of the Newborns

Sixty-eight patients with normal fetal echocardiography were normal in the postnatal period. Prenatal and postnatal diagnoses were shown in Table 2.

i. Acyanotic Congenital Heart Disease

Seventeen small perimembranous and muscular VSDs were seen

to be closed in 15 postnatal periods. Of the eight VSDs of medium and large size, two of them were perimembranous and small in the postnatal period, while two muscular VSD were found to be of medium size. Pulmonary banding was performed in four of these patients, and VSD closure was performed in two of these patients.

In one of the two patients with arcus hypoplasia, hypoplasia improved during antenatal follow-up. In a patient with aortic coarctation, the shelf-like appearance persisted in the postnatal period but is not clinically monitored because no significant gradient was achieved. One patient had a right aortic arch. One patient was followed up due to mild valvular pulmonary stenosis during antenatal follow-up, and there was no increase in valvular stenosis in the postnatal period.

Three of the four patients with mild or moderate tricuspid insufficiency referred for fetal echocardiography improved in the postnatal period, and one patient had postnatal minimal tricuspid insufficiency. Eleven patients had hyperechogenic foci, and all of them disappeared except one case in which rhabdomyoma was considered postnatally, tuberous sclerosis is being investigated now in that patient.

ii. Complex Congenital Heart Diseases

One of the three cases with AVSD was diagnosed as a double outlet right ventricle. One of the two patients diagnosed with partial AVSD was postnatally normal. Pulmonary atresia + VSD was diagnosed in one of the four patients diagnosed with tetralogy of Fallot in the antenatal period. There were two cases with double outlet right ventricle in the antenatal and postnatal period, and one patient with prenatal unbalanced AVSD was diagnosed with double outlet right ventricle. One patient was diagnosed with DORV + AVSD and postnatally confirmed. There was a patient with DILV, VA discordance, aortic hypoplasia and bulboventricular foramen ovale. Four patients diagnosed with tricuspid atresia prenatally were operated postnatally. Two patients diagnosed with hypoplastic left heart died postnatally before the operation.

iii. Arrhythmia

One patient who was referred for supraventricular tachycardia had pericardial effusion and severe Tricuspid insufficiency. Supraventricular tachycardia and heart failure improved with sotalol and digoxin treatment and the patient was in sinus rhythm postnatally. He had no arrhythmia and heart failure. One newborn with prenatal non-conductive atrial beats, improved after 20 days postnatally, conducted and nonconducted atrial beats disappeared spontaneously. One fetus with sinus tachycardia was diagnosed with neonatal graves in the postnatal period and is receiving beta-blocker and methimazole treatment. Antenatal findings of pericardial effusion and mild tricuspid insufficiency improved in postnatal period.

DISCUSSION

Fetal cardiology is one of the most exciting and rapidly developing fields in pediatric cardiology. Fetal echocardiography is an easy, noninvasive and reliable diagnostic tool to perform with high sensitivity and specificity (3). Considering that congenital heart disease is the cause of 42% infant death, the importance of antenatal diagnosis is obvious (4). Antenatal diagnosis has prognostic importance on infant survival, especially in infants with hypoplastic left heart

syndrome and transposition of great arteries (2, 5).

The optimal timing of fetal echocardiography is 18–22 gestational week (6). The average gestational week in the first evaluation was 24 ± 4.2 in our study. In other studies, fetal echocardiography was performed in similar gestational weeks (7, 8). The most common reason for admission to our clinic was the suspicion of CHD in accordance with the literature (7, 8).

Diagnosis was cyanotic congenital heart diseases in a proportion of 24.2% of the 70 patients and acyanotic congenital heart disease 47.1% of the 70 patients.

Despite increased congenital heart diseases in newborns of mothers with gestational diabetes, no congenital heart anomaly was detected in those referred to our clinic because of maternal gestational diabetes mellitus (9, 10). This may be due to a small number of patients with gestational diabetes mellitus.

Transplacental transfer of maternal thyroid-stimulating hormone receptor antibodies (TRAb) causes a risk for neonatal hyperthyroidism (11). Neonatal hyperthyroidism experienced tricuspid insufficiency and hydrops antenatally and can reveal in the postnatal period (12). In our case, fetal tachycardia was prominent, and after delivery, sinus tachycardia did not resolve and beta-blocker treatment was started. Fetal arrhythmia develops in <0.1 of pregnancies and can be as simple as premature atrial contraction or complicated with hidrops fetalis because of nonsustained supraventricular tachycardia and complete AV block (13).

Fetal supraventricular tachycardia can be difficult to manage antenatally, and it is the most common reason for fetal tachycardia. Perinatal morbidities, hydrops fetalis and premature delivery are the consequences of fetal tachycardia.

In the treatment of supraventricular tachycardia, digoxin is used as first-line treatment mostly; however, flecainide and sotalol can be used as first-line treatment (14, 15). In our patient combination of digoxin and sotalol succeeded and rhythm returned to sinus, hydrops revealed before the delivery. In the follow up after delivery, rhythm holter revealed sinus rhythm. Fetal hydrops and SVT do not carry a higher risk of postnatal SVT (16).

Isolated PACs are benign and resolve spontaneously. One patient in our study had isolated PACs and resolved in 20 days postnatally.

CONCLUSION

The detection of congenital heart diseases in the fetal period is very essential, especially the detection of complex heart anomalies, concerning both providing the necessary counseling to the family and planning the early postnatal period. Also, detecting rhythm problems antenatally provides the chance of treatment before delivery. Therefore, sufficient time should be devoted to fetal echocardiography and should be performed by experienced obstetricians and pediatric cardiologists.

Ethics Committee Approval: This study was approved by the local ethics committee at Istanbul University of Health Sciences Umraniye Training and Research Hospital on 25.29.2019 (protocol number 25.09.2019.19527).

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – EE; Design – EE; Supervision – EE; Data Collection and/or Processing – ÖS; Analysis and/or Interpretation – EE; Literature Search – ÖS; Writing – EE; Critical Reviews – ÖS.

Conflict of Interest: The authors have no conflict of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

REFERENCES

1. Donofrio MT, Moon-Grady AJ, Hornberger LK, Copel JA, Sklansky MS, Abuhamad A, et al; American Heart Association Adults With Congenital Heart Disease Joint Committee of the Council on Cardiovascular Disease in the Young and Council on Clinical Cardiology, Council on Cardiovascular Surgery and Anesthesia, and Council on Cardiovascular and Stroke Nursing. Diagnosis and treatment of fetal cardiac disease: a scientific statement from the American Heart Association. *Circulation* 2014; 129(21): 2183–242. [CrossRef]
2. Weber RW, Stiasny B, Ruecker B, Fasnacht M, Cavigelli-Brunner A, Valsangiacomo Buechel ER. Prenatal Diagnosis of Single Ventricle Physiology Impacts on Cardiac Morbidity and Mortality. *Pediatr Cardiol* 2019; 40(1): 61–70. [CrossRef]
3. Rakha S, El Marsafawy H. Sensitivity, specificity, and accuracy of fetal echocardiography for high-risk pregnancies in a tertiary center in Egypt. *Arch Pediatr* 2019; 26(6): 337–41. [CrossRef]
4. Ottaviani G, Buja LM. Update on congenital heart disease and sudden infant/perinatal death: from history to future trends. *J Clin Pathol* 2017; 70(7): 555–62. [CrossRef]
5. Domínguez-Manzano P, Herraiz I, Mendoza A, Aguilar JM, Escribano D, et al. Impact of prenatal diagnosis of transposition of the great arteries on postnatal outcome. *J Matern Fetal Neonatal Med* 2017; 30(23): 2858–63. [CrossRef]
6. Rychik J, Ayres N, Cuneo B, Gotteiner N, Hornberger L, Spevak PJ, et al. American Society of Echocardiography guidelines and standards for performance of the fetal echocardiogram. *J Am Soc Echocardiogr* 2004; 17(7): 803–10. [CrossRef]
7. Chitra N, Vijayalakshmi IB. Fetal echocardiography for early detection of congenital heart diseases. *J Echocardiogr* 2017; 15(1): 13–7. [CrossRef]
8. Nair A, Radhakrishnan S. Evaluation of Referral Pattern for Fetal Echocardiography at a Tertiary Care Center in Northern India and Its Implications. *J Obstet Gynaecol India* 2016; 66(Suppl 1): 258–62.
9. Chou HH, Chiou MJ, Liang FW, Chen LH, Lu TH, Li CY. Association of maternal chronic disease with risk of congenital heart disease in offspring. *CMAJ* 2016; 188(17-18): E438–46. [CrossRef]
10. Yu Y, Arah OA, Liew Z, Cnattingius S, Olsen J, Sørensen HT, et al. Maternal diabetes during pregnancy and early onset of cardiovascular disease in offspring: population based cohort study with 40 years of follow-up. *BMJ* 2019; 367: l6398. [CrossRef]
11. Kazakou P, Theodora M, Kanaka-Gantenbein C, Zapanti E, Bouza H, Petropoulou C, et al. Fetal hyperthyroidism associated with maternal thyroid autoantibodies: A case report. *Case Rep Womens Health* 2018; 20: e00081. [CrossRef]
12. Doucette S, Tierney A, Roggensack A, Yusuf K. Neonatal Thyrotoxicosis with Tricuspid Valve Regurgitation and Hydrops in a Preterm Infant Born to a Mother with Graves' Disease. *AJP Rep* 2018; 8(2): e85–8. [CrossRef]
13. Hill GD, Kovach JR, Saudek DE, Singh AK, Wehrheim K, Frommelt MA. Transplacental treatment of fetal tachycardia: A systematic review and meta-analysis. *Prenat Diagn* 2017; 37(11): 1076–83. [CrossRef]
14. Alsaied T, Baskar S, Fares M, Alahdab F, Czosek RJ, Murad MH, et al. First-Line Antiarrhythmic Transplacental Treatment for Fetal Tachyarrhythmia: A Systematic Review and Meta-Analysis. *J Am Heart Assoc* 2017; 6(12): e007164. [CrossRef]
15. Yuan SM. Fetal arrhythmias: diagnosis and treatment. *J Matern Fetal Neonatal Med*. 2019 Mar 18. doi: 10.1080/14767058.2018.1555804. [Epub ahead of print]. [CrossRef]
16. Hinkle KA, Peyvandi S, Stiver C, Killen SAS, Weng HY, Etheridge SP, et al. Postnatal Outcomes of Fetal Supraventricular Tachycardia: a Multicenter Study. *Pediatr Cardiol* 2017; 38(7): 1317–23. [CrossRef]