Acıbadem Univ. Sağlık Bilim. Derg. 2023; 14 (3): 390-396
https://doi.org/10.31067/acusaglik.1194354

ORIGINAL ARTICLE / ARAŞTIRMA YAZISI

Psychiatry / Psikiyatri

Fetal Echocardiography: Is an Anxiety and Stress Factor for Mother and Fetus?

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Received: 25 October 2022
Accepted: 10 April 2023

ABSTRACT

Purpose: There are conflicting data about the effects of fetal echocardiography on the psychiatric symptoms of the mother and cardiac evaluation of the fetus. Based on this, the aim of the study is to investigate maternal anxiety and stress levels before undergoing fetal echocardiography and its possible effect on fetal cardiac measurements.

Methods: This study included 119 pregnant women who evaluated using fetal echocardiography as the study group and 65 healthy pregnant women who evaluated using ultrasonography for routine screening as the control group. All participants filled out State and Trait Anxiety Inventory (STAI), Perceived Stress Scale (PSS), and Beck Depression Inventory (BDI) before assessment. Mitral flow velocity, tricuspid flow velocity, aorta flow velocity, pulmonary artery flow velocity, and fetal heart rate was evaluated by fetal echocardiography.

Results: STAI-S, STAI-T, and PSS scores of women who were evaluated by using fetal echocardiography were higher than the control group. In the fetal echocardiography group, the aorta flow velocity values of pregnant women with high STAI-S scores were higher than those with low STAI-S scores. Fetal heart rate was higher in pregnant women with low STAI-T scores compared to pregnant women with high STAI-T scores. Correlation analyses showed that STAI-S scores and aorta flow velocity values and the number of pregnancies were positively correlated. In addition, fetal heart rate was found to be negatively correlated with STAI-S, STAI-T, and PSS scores.

Conclusion: Fetal echocardiography can cause anxiety and stress in pregnant women and may have negative effects on fetal cardiac evaluation.

Keywords: anxiety, depression, echocardiography, pregnancy

Fetal Ekokardiyografi: Anne ve Fetüs için Kaygı ve Stres Faktörü müdür?

ÖZET

Amaç: Fetal ekokardiyografinin annenin psikiyatrik semptomları ve fetüsün kardiyak değerlendirmesi üzerindeki etkileri hakkında çelişkili veriler vardır. Buradan yola çıkarak çalışmanın amacı fetal ekokardiyografi yapılmadan önce maternal kaygı ve stres düzeylerini ve bunun fetal kardiyak ölçümler üzerine olası etkisini araştırmaktır.

Yöntem: Bu çalışmaya, çalışma grubu olarak fetal ekokardiyografi kullanılarak değerlendirilen 119 gebe ve kontrol grubu olarak rutin tarama için ultrasonografi kullanılarak değerlendirilen 65 sağlıklı gebe dahil edildi. Tüm katılımcılar, ultrasonografi değerlendirmesinden önce durumluk ve sürekli kaygı envanteri (STAI), algılanan stres ölçeği (PSS) ve beck depresyon envanteri'ni (BDI) doldurdu. Mitral akış hızı, triküspit akış hızı, aort akış hızı, pulmoner arter akış hızı, fetal kalp hızı fetal ekokardiyografi ile değerlendirildi.

Bulgular: Fetal ekokardiyografi ile değerlendirilen gebelerin STAI-S, STAI-T ve PSS puanları kontrol grubuna göre daha yüksekti. Fetal ekokardiyografi grubunda STAI-S skoru yüksek olan gebelerin aort akış hızı değerleri, STAI-S skoru düşük olanlara göre daha yüksekti. STAI-T skoru düşük olan gebelerde fetal kalp hızı, STAI-T skoru yüksek olan gebelere göre daha yüksekti. Korelasyon analizleri, STAI-S skorları ile aort akım hızı değerleri ve gebelik sayısı arasında pozitif korelasyon olduğunu gösterdi. Ayrıca fetal kalp hızının STAI-S, STAI-T ve PSS puanları ile negatif korelasyon gösterdiği bulundu.

Sonuç: Fetal ekokardiyografi, gebelerde anksiyete ve strese neden olabilir ve fetal kardiyak değerlendirmeyi olumsuz etkileyebilir.

Anahtar Kelimeler: anksiyete, depresyon, ekokardiyografi, gebelik

Fetal echocardiography is a detailed sonographic evaluation tool used to assess prenatal fetal cardiac structure and function, and detect fetal heart abnormalities (1). Fetal echocardiography, which was used to be mainly used for evaluating congenital heart disease (CHD), is now routinely required in cases such as having a family history of CHD, as a screening test to detect abnormalities (2). In addition, the guidelines recommend fetal echocardiography if the mother has a metabolic disease such as diabetes, or if she has a history of in vitro fertilization and multiple pregnancies (3). Fetal echocardiography has been shown in many studies to reduce neonatal morbidity and possible CHD-related mortality (4). It has been noted that most cases of CHD diagnosed before the delivery are seen in pregnancies without a defined risk factor (5). For these reasons, the number of pregnant women referred for fetal echocardiography for routine control without any risk factors is increasing. Although fetal echocardiography imaging is increasing, there are limited data on the effect of its application on the psychological well-being of the mother and on the cardiac evaluation of the fetus. Studies on this subject have reported that normal fetal echocardiography results reduce anxiety (6). However, the anxiety of pregnant women was retrospectively evaluated in studies long after fetal echocardiography imaging and studies that evaluated the mother's anxiety levels before the fetal echocardiography are rare. In a study that evaluated maternal anxiety before fetal echocardiography, high levels of anxiety were reported in pregnant women admitted for fetal echocardiography compared to women who did not (7). For this reason, clinicians should consider psychiatric symptoms in women undergoing prenatal diagnostic procedures.

Routine obstetric ultrasonography assessments have been shown to be a positive and quite a desirable experience for most pregnant women (8). However, detection of unexpected conditions, such as suspected chromosomal abnormalities and fetal structural abnormalities, during a routine USG scan has been reported to lead pregnant women to think negatively and experience intense anxiety (9). Prenatal screening experience, including fetal echocardiography, has been found to be a factor of stress for mothers and their partners due to the fear of diagnosis about their babies during pregnancy (10). In addition, waiting for a prenatal diagnosis can cause a depressed mood, guilt, lack of motivation, and feelings of helplessness (11). Data from all these studies support the idea that more attention should be paid to the psychological state of the mother during the evaluation of pregnancy-related medical conditions.

A referral to a specialist for fetal echocardiography for a suspected fetal anomaly or for routine control can be a source of anxiety and stress for an expectant mother. Based on this, the aim of the study is to investigate maternal anxiety and stress levels before undergoing fetal echocardiography and its potential effect on fetal cardiac measurements. We hypothesize that fetal echocardiography is an imaging tool that can lead to anxiety and stress in pregnant women, and anxiety that occurs before the procedure can have a negative impact on fetal cardiac evaluation.

Materials and Methods

Procedure

This cross-sectional study was conducted with pregnant women admitted to a maternity and child hospital. Women who were evaluated with fetal echocardiography for the first time were included in the study as the study group. As a control group, healthy pregnant women who have no problems related to pregnancy and fetuses and who did not undergo fetal echocardiography were included. Participants' anxiety, stress, and depression levels were evaluated using various scales. The scales were filled in by participants half an hour before fetal echocardiography. All participants gave their written informed consent after the investigators had explained the aim and course of the study. Oral assent was also obtained from all participants.

Materials

State-Trait Anxiety Inventory (STAI)

STAI is a 40-item self-report scale, developed by Spielberger to measure an individual's state and trait anxiety levels (12). The scale has two different forms consisting of 20 items, measuring state anxiety (STAI-S) and trait anxiety (STAI-T). The score ranges from 20 to 80 on the 4-point Likert-type scale, which is rated from 1 (never) to 4 (completely). The validity and reliability study of the scale for our country was conducted by Oner and Le Compte (13). STAI is widely used to assess anxiety during pregnancy, and the cut-off score was taken as 40 (high anxiety) in the studies conducted so far (14).

Perceived Stress Scale (PSS)

PSS has been designed to measure the degree of perceived stress in an individual's life caused by some circumstances (15). Participants evaluate 10 items on the scale on a five Likert-type scale, which ranges from never (0) to very often (4). The validity and reliability study of the scale for our country was conducted by Eskin et al. (16). Cut-off score of PSS was taken as 15 (high stress) in the studies conducted so far (17).

Beck Depression Inventory (BDI)

BDI is a 21-item self-report scale designed to assess the severity of depressive symptoms (18). BDI is the most widely used depression measurement tool around the world. The validity and reliability study of the scale for our country was conducted (19).

Fetal Echocardiography

Fetal echocardiography was performed with Philips Affiniti 50 (Philips Healthcare, Andover, Netherlands) by the same observer and an echocardiographic scanner with 2.5-5 MHz transducers was used. The fetal examination included the standard techniques to evaluate the position and axis of the heart and for scanning plans and conventional Doppler and M-mode measurements (20). The structural disorders of the heart were evaluated by a two-dimensional ultrasound imaging technique and the rhythm and dimensions of the heart were evaluated by the M-mode technique (21).

Statistical Analysis

The data were analyzed using SPSS 20 software (IBM Corporation, Armonk, NY, USA). The data were presented as mean (standard deviation [SD]) for numerical variables and percentages for categorical variables. The Kolmogorov-Smirnov normality test was used to determine whether the variables have a normal distribution. Chi-square (χ^2) test was used to compare categorical variables and frequencies. Continuous variables were expressed by means (SD). Student's t-test was used to compare the variables with normal distribution between the two groups. The Mann-Whitney U test was used to analyze non-normally distributed variables. Bivariate correlations were evaluated using Pearson's correlation analyses to determine the association between psychiatric variables and fetal echocardiography measurements. All statistical analyses were performed within a 95% confidence interval, and a p-value of <0.05 was considered statistically significant.

Results

This study was conducted with 119 pregnant women in the study group who were assessed with fetal echocardiography, and 65 healthy pregnant women who were assessed with routine USG screening in the control group. The sociodemographic and clinical characteristics of the women are presented in Table 1. The mean age of the women who were assessed with fetal echocardiography was 26.34±4.8, and 26.89±4.32 in the control group (p=0.293). There was no statistically significant difference between the two groups in terms of participants' educational level and family income (p>0.05). The mean gestational age of the women who were assessed with fetal echocardiography was 25.47±4.95, and 26.56±8.65 in the control group (p=0.107). Of the women who were assessed with fetal echocardiography, 40 (33.6%) had their first pregnancy, 79 (66.4%) had their second or later pregnancies. In the control group, 17 (26.1%) had their first pregnancy, 48 (73.9%) had their second or later pregnancies (p=0.296). In the fetal echocardiography group, 92 (77.3%) had no history of miscarriage, while 19 (15.9%) had one miscarriage, and 8 (6.8%) had a history of two or more miscarriages. In the control group, 44 (67.6%) had no history of miscarriage, 11 (16.9%) had one miscarriage, and 10 (15.5%) had a history of two or more miscarriages (p=0.152).

A comparison of the psychiatric variables between the study groups is shown in Table 2. STAI- S and STAI-T scores of the women who were assessed with fetal echocardiography were statistically significantly higher than in the control group (p=0.001 and p=0.006, respectively). In addition, PSS scores were statistically significantly higher in the fetal echocardiography group than in the control group (p=0.002).

A comparison of mitral flow velocity (MFV), tricuspid flow velocity (TFV), aorta flow velocity (AFV), pulmonary artery flow velocity (PFV), and fetal heart rate (FHR) measured in fetal echocardiography according to the STAI-S, STAI-T, and PSS groups is shown in Table 3. AFV values (0.765, vs. 0.683 cm/sec) of the women with high STAI-S scores compared to women with low STAI-S scores were statistically significantly higher (p=0.014). FHR (150.2/min vs. 147.1/min) was statistically significantly higher in pregnant women with low STAI-T scores than in pregnant women with high STAI-T scores (p=0.016).

Correlation analyses between psychiatric variables and fetal echocardiography parameters are shown in Table 4. A positive correlation was found between AFV and STAI-S scores (r=.186, p=0.043). In addition, a negative correlation was found between FHR and STAI-S (r= -.235, p = 0.014), STAI-T (r=-.222, p=0.021), and PSS (r=-.220, p=0.021) scores.

Table 1. Demographic and clinical characteristics of the participants

Variables		Fetal echocardiography (n: 119)	Control (n: 65)	t/z/x²	p
Age (years), mean+sd		26.34±4.80	26.89±4.32	0.917[c]	0.293
Gestational age (weeks), mean+sd		25.47±4.95	26.56±8.65	0.125[b]	0.107
Previous miscarriage, n (%)		27 (22.7)	21 (32.4)	1.064[a]	0.152
Number of pregnancies, n (%)	Primigravida	40 (33.6)	17 (26.1)	1.942[a]	0.296
	Multigravida	79 (66.4)	48 (73.9)		
Education level, n (%)	Primary School	15 (8.2)	11 (6)	0.657[a]	0.190
	Middle School	44 (23.9)	32 (27.4)		
	High School	33 (17.9)	13 (7.1)		
	University	27 (14.7)	9 (4.9)		
Family income, n (%)	Not regularly	32 (17.4)	19 (10.3)	1.160[a]	0.694
	Low	33 (17.9)	22 (12)		
	Middle	48 (26.1)	22 (12)		
	High	6 (3.3)	2 (1.1)		

Sd: standard deviation
[a]Chi square test
[b]Mann–Whitney U test
[c]Student T test

Table 2. Comparison of psychological variables among study groups

Variables	Fetal echocardiography (n: 119)	Control (n: 65)	t/z/x²	p
STAI-S	38.82±10.34	33.65±7.03	2.561[c]	**0.001**
STAI-T	39.78±8.85	35.97±7.29	2.127[c]	**0.006**
PSS	14.95±5.49	12.34±4.72	2.369[c]	**0.002**
BDI	8.43±8.66	9.40±7.29	1.636[b]	0.103

STAI-S: State and trait anxiety inventory – state anxiety form
STAI-T: State and trait anxiety inventory – trait anxiety form
PSS: Perceived stress scale
BDI: Beck depression inventory
[a]Chi square test
[b]Mann–Whitney U test
[c]Student T test

Table 3. Comparison of psychological variables and fetal echocardiography parameters among study groups

Variables		MFV	TFV	AFV	PFV	FHR
STAI-S	High	0.482±0.061	0.492±0.040	0.765±0.242	0.672±0.079	147.1±7.1
	Low	0.474±0.062	0.478±0.057	0.683±0.115	0.641±0.083	149.6±6.5
	p	0.517[b]	0.214[b]	**0.014[c]**	0.064[b]	0.091[c]
STAI-T	High	0.486±0.056	0.490±0.048	0.726±0.118	0.661±0.082	147.1±6.5
	Low	0.469±0.065	0.476±0.057	0.691±0.190	0.642±0.082	150.2±6.6
	p	0.165[b]	0.169[b]	0.257[c]	0.219[b]	**0.016[c]**
PSS	High	0.481±0.055	0.487±0.050	0.719±0.208	0.645±0.077	147.8±6.4
	Low	0.472±0.067	0.477±0.056	0.694±0.117	0.654±0.086	149.8±6.9
	p	0.438[b]	0.330[b]	0.409[c]	0.580[b]	0.127[c]

STAI-S: State and trait anxiety inventory – state anxiety form
STAI-T: State and trait anxiety inventory – trait anxiety form
PSS: Perceived stress scale
MFV: Mitral flow velocity (cm/sn)
TFV: Tricuspid flow velocity (cm/sn)
AFV: Aorta flow velocity (cm/sn)
PFV: Pulmonary artery flow velocity (cm/sn)
FHR: Fetal heart rate (rate/dk)
High: High anxiety levels
Low: Low anxiety levels
aChi square test
bMann–Whitney U test
cStudent T test

Table 4. Correlation analyses between psychiatric variables and fetal echocardiography parameters

Variables	STAI-S		STAI-T		PSS	
	r	p	r	p	r	p
AFV	.186	**0.043**	.123	0.181	.001	0.989
FHR	-.235	**0.014**	-.222	**0.021**	-.220	**0.021**

Bold values indicate statistically significant correlations (p < 0.05)
r: Pearson's correlation
STAI-S: State and trait anxiety inventory – state anxiety form
STAI-T: State and trait anxiety inventory – trait anxiety form
PSS: Perceived stress scale
AFV: Aorta flow velocity
FHR: Fetal heart rate

Discussion

This study investigated depression, anxiety, and perceived stress levels in pregnant women who were assessed with fetal echocardiography by comparing them with the pregnant women who were assessed with routine USG. The study also evaluated the relationship of depression, anxiety, and perceived stress levels with fetal echocardiography parameters. As a result of the study, it was found that STAI-S, STAI-T, and PSS scores were statistically significantly higher in the fetal echocardiography group than in the control group. In addition, AFV values in the fetal echocardiography group were statistically significantly higher in women with a high STAI-S score than in women with a low STAI-S score. However, it was found that women with a low STAI-T score had a statistically significantly higher FHR compared to those with a high STAI-T score. Moreover, determining the maternal anxiety, stress, and depression levels, as well as evaluating the effect of these levels on the fetus in this study makes important contributions to the literature.

USG, which is often used since the first trimester in pregnancy follow-up, it allows pregnant women to adapt psychosocially to the pregnancy process, identify with the role of motherhood and establish positive relationships with their close circle (22). Besides their positive contribution, a negative finding that can be observed at the USG and requires further research becomes a very important source of stress for pregnant women and their families (23). A study conducted on pregnant women referred to fetal echocardiography found that the state anxiety of the pregnant women before the procedure was high, and the that the fetal echocardiography process was an important source of anxiety (7). Another study conducted on this subject found that pregnant women had high state anxiety before the fetal echocardiography and that those with abnormal fetal echocardiography results had higher anxiety levels than those with normal fetal echocardiography results (24). In our study, we found that pregnant women referred for fetal echocardiography had high levels of both state and trait anxiety, before the procedure, compared to the pregnant women who would undergo a routine normal USG procedure. In this study, which is similar to the literature in this respect, it was also found that perceived stress levels were high in the pregnant women who assessed with fetal echocardiography compared to pregnant women who would have normal USG. In their research, Rosenberg et al. (7) studied 40 pregnant women, who were assessed with fetal echocardiography, and found that state anxiety levels were high, but trait anxiety levels and perceived stress levels were normal. In our study, it was found that both state and trait anxiety and perceived stress levels were high in pregnant women who were assessed with fetal echocardiography. However, in our study, state anxiety levels and trait anxiety levels were found to be positively correlated in pregnant women who underwent fetal echocardiography. This finding suggests that individuals with high-state traits may be more affected by further examinations due to a sense of uncertainty or a possibility of negative results. In addition, in our study, the perceived stress levels in pregnant women who assessed with fetal echocardiography were found to have a positive correlation with both state and trait anxiety scores. This result shows that both state and trait anxiety are an important source of stress for pregnant women.

Mental problems during the pregnancy can have long-term effects on both the mother and fetus, as well as their immediate effects. Antenatal maternal stress and anxiety can affect the functioning of the hypothalamo-pituitary-adrenal (HPA) axis, negatively affecting children both in the fetal period and later in life (25). Antenatal maternal stress and anxiety, which often cause HPA axis activation, affect FHR in the fetal period and increase fetal heart rate variability and fetal movements (25, 26).

Although there is no clear information about the short- and long-term consequences of maternal state and trait anxiety, it is known that maternal anxiety and stress affect infants in the postpartum process. Studies have mostly focused on baby development and delivery and postpartum outcomes. However, in the shorter term, data on the fetal echocardiography parameters and hence the effects of antenatal maternal anxiety and stress on the fetus are quite limited. In our study, antenatal maternal anxiety and stress were found to have various effects on fetal echocardiography parameters. In our study, AFV was found to be higher in pregnant women with high-state anxiety than in those with low-state anxiety. We also found that state anxiety scores have a positive correlation with AFV. These results suggest that antenatal maternal state anxiety caused by fetal echocardiography and high levels of anxiety may affect the cardiac function of the fetus. Moreover, FHR was found to be lower in pregnant women with high trait anxiety than in pregnant women with low trait anxiety. However, a small number of studies on this subject have obtained contradictory results. In their study, Monk et al. (27) reported that, high maternal state anxiety increases FHR, while Sjöström et al. (28) reported that, both state and trait anxiety had no effect on FHR. A study conducted in hospitalized high-risk pregnant women also found that maternal state anxiety was high compared to the control group, but there was no difference between the study groups in terms of FHR (29). In our study, no relationship was found between increased maternal state anxiety and FHR. In this respect, it shares similar results with the literature. Moreover, Lobmaier et al. (30) suggested that, perceived stress may affect FHR. In our study on this subject, which has quite limited data, no association was found between perceived stress and fetal HR, unlike the literature. Acute anxiety is known to cause increased cortisol secretion by enabling HPA axis activation (31). Different studies on this subject suggest that chronic stress and anxiety affect HPA axis activity, causing a decrease in cortisol secretion (31, 32). For this reason, the fact that maternal trait anxiety is associated with low FHR suggests that long-term anxiety disrupts the functioning of the HPA axis, causing a decrease in FHR.

Our research has a number of limitations. The most important limitation of the study is the screening of psychiatric symptoms through scales without performing psychiatric interviews with the patients who were assessed with fetal echocardiography. Second, in this cross-sectional study, stress and anxiety assessment could not be evaluated in the short and long term after fetal echocardiography assessment.

Conclusion

Fetal echocardiography is an important imaging tool that can lead to anxiety and stress in pregnant women. In addition, anxiety that occurs before the procedure can have a negative impact on fetal cardiac evaluation. For this reason, psychosocial interventions to reduce anxiety and stress in pregnant women who were assessed with fetal echocardiography imaging may be important for fetal and maternal health. A small number of previous studies on this subject have quite contradictory results. For this reason, further studies with larger samples are needed to illuminate the relationship between maternal anxiety and stress with fetal health.

Declarations

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Conflicts of Interest/Competing Interests

No conflicting relationship exists for any author.

Ethics Approval

This study was approved by the Ethics Committee of KTO Karatay University School of Medicine (22.05.2020; decision number 2020/020). All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Availability of Data and Material

The data that support the findings of this study are available from the corresponding author, [MAA], upon reasonable request.

Authors' Contributions

MAA: Designed the study, performed the analysis, wrote the paper. NU: Designed the study, wrote the paper. HA: collected the data. MK: collected the data.

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