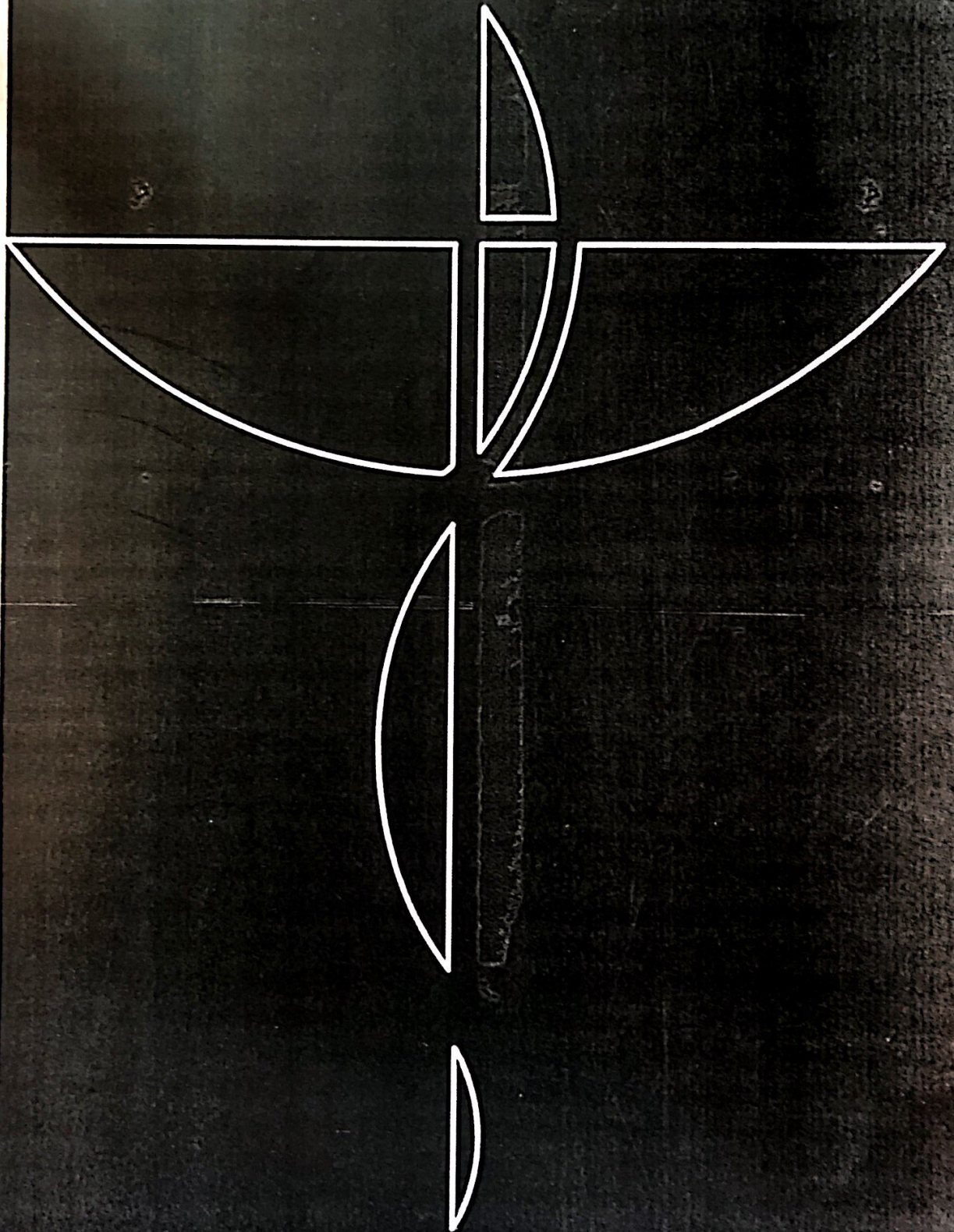


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# USEFULNESS OF ECHOCARDIOGRAPHY IN DETECTING HEART ABNORMALITIES IN PREGNANCIES WITH PREECLAMPSIA/GESTATIONAL HYPERTENSION

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## Abstract

**Introduction:** Preeclampsia is a disorder in pregnancy which includes high blood pressure and proteinuria. It is recognized in 5-8% of all pregnancies. In the last several years an association between heart abnormalities and preeclampsia has been observed. Echocardiography as an imaging method is increasingly being used in obstetrics in the management of hemodynamic changes which occur in normal but also in pregnancies with preeclampsia. The aim of the study was to determine the usefulness of echocardiography in the control of pregnancies complicated with preeclampsia/gestational hypertension.

**Materials and methods:** A total of 38 patients were analyzed in our study. It was realized at the University Clinic for Gynecology and Obstetrics and University Clinic for Cardiology. Pregnant women were recruited from the Outpatient clinic at the University Clinic for Gynecology and Obstetrics. After signing an informed consent for participation in the study pregnant women were divided in two groups (normotensive and pregnancies with gestational hypertension/preeclampsia). Echocardiographic examination was done at patients' entry in the study.

**Results and discussion:** In more than 38% of the cases in the examined group with hypertension an abnormal heart remodeling was seen with asymptomatic left ventricular dysfunction/hypertrophy. In the normotensive control group the heart function was normal in all evaluated cases.

**Keywords:** echocardiography, pregnancies, preeclampsia, heart abnormality, prevention

## ЗНАЧЕЊЕ НА ЕХОКАРДИОГРАФИЈАТА ВО ОТКРИВАЊЕ НА СРЦЕВИ АБНОРМАЛНОСТИ КАЈ ТРУДНИЦИ СО ПРЕЕКЛАМПСИЈА/ГЕСТАЦИСКА ХИПЕРТЕНЗИЈА

### Апстракт

**Вовед :** Прееклампсија претставува состојба во бременоста која се манифестира со појава на зголемен крвен притисок и протеинурија, а се среќава кај 5-8% од бремените жени. Последниве години забележана е поврзаност на прееклампсијата со промени во срцевата структура и функција. Ехокардиографијата како неинвазивна техника за визуелизација на срцето сè повеќе се користи во следење на срцевата функција и хемодинамските промени поврзани со бремености, но и кај бремености кај кои се појавува прееклампсија.

Целта на овој труд беше да се прикаже користа од ехокардиографијата во контрола на срцевата функција кај трудници со прееклампсија/гестациска хипертензија.

**Материјали и методи:** Во оваа студија анализиравме 38 бремени пациентки. Студијата се спроведуваше на Универзитетската клиника за гинекологија и



акушерство и на Универзитетската клиника за кардиологија. Трудниците беа регрутирани на Клиниката за гинекологија и акушерство каде по потпишаната информирана согласност за учество во студијата беа поделени во две групи (нормотензивни и трудници со гестациска хипертензија/пreeклампсија). Кај сите пациентки при влез во студијата беше направен Доплер ехокардиографски преглед. Резултати и дискусија: Во рамките на студијата добиените резултати ја потврдија улогата на ехокардиографијата во следење на срцевата функција кај трудници со пreeклампсија/гестациска хипертензија. Во испитуваната група на трудници со гестациска хипертензија/пreeклампсија кај 38% од случаите се забележа срцево ремоделирање, односно асимптоматска левокоморна дисфункција/хипетрофија. Во контролната (нормотензивна) група кај ниту една трудница ехокардиографски не беа забележани промена во левокоморната функција.

**Клучни зборови:** ехокардиографија, трудници, пreeклампсија, срцево оштетување, превенција

## Introduction

During the stage of pregnancy, the heart goes through a cycle of remodeling similar to the changes seen in athletes<sup>i</sup>. Dimension of the left ventricle increases and there are changes in ventricular wall thickness and mass<sup>ii</sup>. As a definition, preeclampsia is a condition that is manifested with high blood pressure and proteinuria. It is seen in 5-9% of pregnancies<sup>iii</sup>. Increased blood pressure in pregnancy is defined as blood pressure > 140/90 and increased values of urine protein > 0.3gr/l<sup>iv</sup>. Preeclampsia usually occurs in the last trimester of pregnancy. From the first onset of preeclampsia and as the pregnancy progresses the condition worsens<sup>v</sup>. In terms of classification there are several dilemmas and different opinions; namely some of the

authors classify it as light, mild and heavy preeclampsia while other classify it according to the gestational week as late or early preeclampsia. Newer studies classify preeclampsia as early and late preeclampsia. The explanation behind this is that they are two different entities responsible for their development<sup>vi</sup>.

Early preeclampsia appears before the 34 gestational week and is associated with abnormal Doppler findings on the uterine artery, fetal growth restriction as well as bad perinatal outcome for both mother and baby<sup>vii</sup>. Late preeclampsia on the other hand occurs after the 34 gestational week and is usually seen as normal or slightly increased resistance in the uterine artery and is associated with a better perinatal outcome<sup>viii</sup>. Major abnormalities that define heart remodeling in preeclampsia are concentric remodeling of left ventricle along with diastolic dysfunction and reduced contractility<sup>ix</sup>. These abnormalities in the heart function according to AHA (American Heart Association) are identified as B stage of heart failure<sup>x</sup>. Progression from stage B (asymptomatic) to stage C (symptomatic) increases fivefold the likelihood of cardiovascular death. Early recognition of asymptomatic heart changes (stage B) helps in early therapeutic interventions<sup>xi</sup>. Echocardiography is increasingly being used in obstetrics in determining hemodynamic and/or structural abnormalities of the heart which occur in normal but also in pregnancies with preeclampsia.

The goal of the study was to determine the usefulness of echocardiography and to identify possible structural and/or functional abnormalities in pregnancies with preeclampsia/gestational hypertension.



## Material and methods

Thirty-eight pregnant women were enrolled in our study that was approved by the Ethics Committee of the Medical Faculty in Skopje. All women were recruited from the University Clinic for Gynecology and Obstetrics in Skopje. Women were eligible to be included in the study if they were between 28th and 34th gestational week. Initially, all patients underwent clinical and obstetric examinations. Exclusion criteria were: unclear gestational age, twin pregnancy, history of previous heart condition, preexisting chronic condition, diabetes, chromosome or ultrasound suspected malformation. All eligible pregnant women signed an informed consent for participation in the study.

According to blood pressure measurements and the results of laboratory blood analysis eligible pregnant women were divided in two groups: the first group (19 patients) consisted of pregnant women who abided by the criteria for gestational hypertension/preeclampsia, while the second group (19 patients) were controls with normotensive pregnancy. Obstetric examination was done using commercially available ultrasound, Volvuson 730 pro. Gestational hypertension was confirmed if there were two measurements of blood pressure  $\geq 140/90$  mmHg (obtained at least 4 hours apart) in women with no prior history of hypertension<sup>xii</sup>. The diagnosis of preeclampsia was confirmed if increased blood pressure was measured twice  $\geq 140/90$  and if there was proteinuria  $\geq 0.3$ mg/l or qualitative (+) present. After the initial selection, no later than 24h, patients were sent to the University Clinic for Cardiology for echocardiographic examination.

All patients underwent transthoracic echocardiographic examination using commercially available ultrasound system GE Vivid 7 with phased array transducer. Patients were examined in left lateral decubitus position. Two-dimensional, M-mode, pulse wave Doppler (PWD), color Doppler and tissue Doppler imaging (TDI) were used to assess the heart morphology and function. The examination was performed in accordance with the recommendations of the American Society of Echocardiography and European Association of Cardiovascular Imaging.

The following parameters were measured for the evaluation of LV geometry and function according to ASE/EACI recommendations: dimensions of heart chambers, LV dimensions and volumes, LV wall thickness. Left ventricular systolic function was expressed as ejection fraction using the Teicholz method and  $EF > 55\%$  was considered as normal systolic function. PW Doppler and TDI were carried out to assess LV diastolic function, according to the contemporary guidelines. 2D echocardiography, conventional and color Doppler were used for assessment of valvular morphology and function.

### *Statistical analyses*

Statistical analysis was performed by using commercial statistical package SPSS 8.0, Chicago IL. Descriptive data are shown as means and standard deviations. Independent t-test for continuous data and  $\chi^2$  tests for categorical data were used for comparison between normotensive and gestational hypertension/preeclampsia groups. A p value  $< 0.05$  was considered statistically significant.

### **Results**

A total of 38 patients were evaluated. The group with gestational hypertension/preeclampsia was composed of 19 patients and the control group consisted of 19 normotensive pregnancies. Demographic characteristics are shown in Table 1. The mean age of patients with gestational hypertension/preeclampsia was  $32.8 \pm 4.5$  years and of control group  $28 \pm 2.8$ , which showed statistically significant difference ( $p=0.05$ ). Average BMI in patients with



gestational hypertension/preeclampsia was  $31.8 \pm 4.9 \text{ kg/m}^2$  and in normotensive pregnant women  $24.8 \pm 3.6 \text{ kg/m}^2$ , with statistical significance of  $p < 0.01$ . In the hypertension group the average BMI was between 30 and  $34.9 \text{ kg/m}^2$  (light obesity) while in the control group the average BMI was in normal range ( $18$  to  $24.9 \text{ kg/m}^2$ ).

**Table 1** Clinical and demographic characteristics of pregnant women with gestational hypertension/preeclampsia and controls (normotensive pregnancies)

	Normal pregnancies (n=19)	Gestational hypertension /preeclampsia (n=19)	P value
Age, y	$28.0 \pm 2.8$	$32.8 \pm 4.5$	$P = 0.05$
BMI, kg/m <sup>2</sup>	$24.8 \pm 3.6$	$31.8 \pm 4.9$	$P < 0.01$
Systolic BP, mmHg	$112 \pm 8$	$156 \pm 14$	$P < 0.001$
Diastolic BP, mmHg	$78 \pm 8$	$103 \pm 17$	$P < 0.001$
Heart rate, bpm	$82.2 \pm 14.2$	$83.3 \pm 12.9$	NS
Mode of delivery			
Section cesarean (n,%)	9 (47%)	14 (74%)	
Spontaneous vaginal (n,%)	10 (53%)	5 (26%)	
Time of delivery wk gestational	$39.6 \pm 0.4$	$35.4 \pm 2.9$	$P < 0.005$

Concerning the obstetrical history there was a significant difference in the gestational age when women were delivered. Pregnant women with gestational hypertension/preeclampsia had smaller gestational age at the time of delivery ( $35.4 \pm 2.9 \text{ wk}$ ) compared with normal pregnancies ( $39.4 \pm 0.6 \text{ wk}$ ). There were more cesareans among women with gestational hypertension/preeclampsia than in normal pregnancies (74% vs. 47%, respectively).

**Table 2** Echocardiographic parameters of LV geometry and systolic function in pregnant women with gestational hypertension/preeclampsia and controls (normotensive pregnancies)

	Normal pregnancies (n=19)	gestational hypertension /preeclampsia (n=19)	P value
LVDd, mm	$49.1 \pm 2.3$	$47 \pm 2.1$	$P = 0.05$
LVDs, mm	$31.1 \pm 2.9$	$31.2 \pm 1.0$	NS
LVVd, ml	$102.2 \pm 6.7$	$97.2 \pm 2.5$	NS
LVVd, ml	$35.1 \pm 3.6$	$35.6 \pm 1.5$	NS



IVS, mm	10.8±0.4	11.6±0.8	p<0.05
PWd, mm	8.6±0.9	8.6±0.4	NS
LA, mm	31.8±3.4	34.7±3.1	P=0.05
LVM, gr	104±15	125±19	p<0.001
EF (%)	64±1.7	65.9±4.2	NS
FS (%)	34.8±1.5	36.8±2.5	NS

**Table 3** Doppler-echocardiographic parameters of LV diastolic function in pregnant women with gestational hypertension/preeclampsia and controls (normotensive pregnancies)

	Normal pregnancies (n=19)	gestational hypertension /preeclampsia (n=19)	P value
Mitral E wave, m/s	0.74±0.04	0.69±0.05	P < 0.05
Mitral A wave, m/s	0.61±0.04	0.66±0.12	NS
Deceleration time, ms	191±4.8	215.1±16.8	P < 0.005
Mitral E/A ratio	1.2±0.07	1.08±0.23	NS
E', cm/s	9.5±1.1	8.2±1.6	P < 0.05
E/E' ratio	8.1±0.5	9.9±2.0	P < 0.05
LA, mm	31.8±3.4	34.7±3.1	P=0.05

All pregnant women (from both groups) had normal LV systolic function expressed as ejection fraction and fractional shortening (Table 2). Left ventricular end-diastolic dimensions were significantly greater in hypertensive/preeclamptic pregnancies than in controls (p<0.05). Early LV remodeling manifested with LV hypertrophy was identified in 8 (40%) hypertensive/preeclamptic pregnancies and in none of normal pregnancies. Mean LV mass and IVS thickness were significantly higher in pregnancies with gestational hypertension/preeclampsia compared to normal pregnancies (104±15 g vs. 125±19g, p<0.001 and 11.6±0.8 mm vs. 10.8±0.4mm, p<0.05 respectively).

Doppler-echocardiographic parameters of LV diastolic function in normotensive and hypertensive/preeclamptic pregnancies are shown in Table 3. In the group of pregnancies with gestational hypertension/ preeclampsia 6 (37%) patients had diastolic dysfunction according to the parameters of diastolic function assessed with PWD and TDI. Thirteen (73%) patients had normal trans-mitral flow velocities and mitral annulus velocities assessed with TDI. In the group of normal pregnancies all women had normal LC diastolic function assessed with PWD and TDI.

**Discussion**

Cardiovascular implications in pregnancy continue to play an issue even after the pregnancy has ended. Cardiovascular derangements are mostly seen in pregnant women with



hypertension and preeclampsia/eclampsia. As hypertension occurs in 10% and preeclampsia is seen in 5-6% of all pregnancies<sup>xiii</sup> the importance of this issue is obvious and need a comprehensive approach in pregnant women at increased risk. Echocardiography is widely used noninvasive imaging technique for determining cardiac structure and function so it seems to have a significant role in determining cardiovascular abnormalities in pregnant women with gestational hypertension/preeclampsia.

Our results have shown that main risk factors for heart abnormalities detected with echocardiography are BMI and hypertension. In the hypertension group the average BMI was between 30 to 34.9 kg/m<sup>2</sup> (light obesity) while in the control group the average BMI was in the normal range (18.5 to 24.9 kg/m<sup>2</sup>). Many studies have reported that BMI is an independent risk factor for both hypertension and left ventricle abnormalities. It may contribute to the development of late preeclampsia (>34 gestational week)<sup>xiv</sup>. In our study age of pregnant women was not associated with an increased incidence of heart abnormalities. Age might not be an issue due to the small number of patients in our study.

In the group consisting of pregnant women with gestational hypertension/preeclampsia evaluated hypertension group abnormalities of heart structure and function were identified using echocardiography in nearly 40% of the patients. These women are at risk and they should be followed more closely. In our study the left ventricular hypertrophy and LV diastolic dysfunction with abnormal myocardial relaxation were predominant heart abnormalities among pregnant women with preeclampsia/gestational hypertension. All pregnant women with identified cardiac abnormalities were asymptomatic. Our results are in concordance with the results of several other studies. Results from other studies have shown that in pregnancies complicated with preeclampsia, especially early preeclampsia (< 34 gestational week), heart abnormalities are more frequent and more severe<sup>15</sup>. Most of these patients remain hypertensive long after the pregnancy has ended and require additional follow up and antihypertensive treatment. The cardiac abnormalities in hypertensive pregnancies can be reversible after delivery and with regulation of blood pressure, but the resolution is incomplete in most preeclamptic women 3 months post-delivery. In the study of Melchiorre et al.<sup>xv</sup> hypertensive women diagnosed with preeclampsia were further divided in two groups (preterm and term preeclampsia). One year post-delivery more than 50% preterm preeclampsia had still met the criteria for left diastolic dysfunction. In the group with term preeclampsia diastolic dysfunction was normal but with persistent impairment of myocardial relaxation. Mi-Jeong Kim et al.<sup>xvi</sup> in their recent study reported that increased BMI was significantly associated with left ventricular hypertrophy in hypertensive pregnancies. The results from all these studies confirm our preliminary results.

#### Study limitations

The small sample size poses some limitations. Hopefully these results will open the way for a larger study, which would involve more multidisciplinary approach between cardiologists and obstetricians.

#### Conclusion

Cardiovascular implications in pregnancy continue to play an issue even after the pregnancy has ended. Our study has shown that echocardiography has a significant role in determining asymptomatic abnormalities of heart function and structure in pregnant women with gestational hypertension/preeclampsia. LV hypertrophy and/or diastolic dysfunction are main cardiac abnormalities in these patients and systolic function is rarely affected.

The goal and the ultimate value of the study will be in finding asymptomatic cases with heart damage before they manifest symptoms in future. The study will help increase the awareness among obstetricians that hypertension increases the risk of heart damages and



that with early recognition and life style changes some of these changes can be preventable. The inclusion of mandatory echocardiography and follow-up of these patients after delivery will help identify high risk cases.

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