



### LEFT VENTRICULAR SYSTOLIC DYSFUNCTION IN PREGNANT WOMEN WITH PRE-ECLAMPSIA WITHOUT PROTEINURIA

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#### ABSTRACT

The article presents the main pathophysiological mechanisms associated with the development of pregnancy complications on the background of arterial hypertension in patients without clinical manifestations of left ventricular dysfunction, shows the possibilities of speckle-tracking echocardiography in detecting latent systolic dysfunction of the left ventricle in pregnant women on the background of preeclampsia, not accompanied by proteinuria.

**Goal.** To determine early markers of left ventricular systolic dysfunction in pregnant women with preeclampsia without proteinuria using speckle-tracking echocardiography.

**Material and methods.** 38 pregnant women with preeclampsia with a gestation period of 29-40 weeks were divided into 2 groups: group 1 - 19 patients without a history of hypertension, group 2 – 19 patients with a history of hypertension (without proteinuria during pregnancy). Echocardiography with assessment of cardiomyocyte function by speckle tracking was performed on ultrasound scanners Apliotm 500 and Apliotm Artida by Toshiba.

**Results.** The left ventricular ejection fraction in the groups did not significantly differ, while the longitudinal, radial and circular deformations differed between the groups, while the lowest indicators characterized the global longitudinal deformation.

**Conclusions.** In assessing the function of the left ventricle in pregnant women with preeclampsia without daily proteinuria, it is not enough to focus on traditional parameters, shifting the emphasis towards the derivatives of strength, speed and time. The study of the myocardium using speckle-tracking echocardiography contributes to the detection of subclinical left ventricular dysfunction in patients with arterial hypertension without daily proteinuria.

**Keywords:** preeclampsia, arterial hypertension, myocardial deformity, speckle-tracking echocardiography, ejection fraction, proteinuria.

#### INTRODUCTION

Currently, the therapy of arterial hypertension (AH) during pregnancy is given special importance. At the same time, the pathogenesis of a severe complication of pregnancy occurring against the background of increased blood pressure (BP) – preeclampsia (PE), where the leading importance is given to a combination of factors: inhibition of cytotrophoblast invasion into the spiral arteries of the uterus, endothelial dysfunction, oxidative stress,



hypercoagulation, microcirculation disorders. It is known that changes in the emerging placenta eventually lead to its hypoxia and contribute to the development of placental insufficiency, and spreading to the vital organs of a pregnant woman, form specific clinical manifestations of PE. It is proved that with early onset PE, the frequency of various complications is 1.5–3.4 times higher than with its late manifestation. At the same time, some patients with eclampsia have no proteinuria. There are moderate and severe PE, PE on the background of pre-existing hypertension, gestational hypertension and further eclampsia.

The question of myocardial damage and its pathogenesis in hypertension during pregnancy and PE is still open. Most authors point to the preserved ejection fraction (EF) of the left ventricle (LV) in patients with PE and AH, however, when assessing EF, the systolic function of the LV is not properly evaluated.

Work on the assessment of systolic heart function, including in patients with preserved EF, was conducted under the guidance of. They determined the criteria for the effectiveness of therapy in patients of various nosological groups based on an assessment of the dynamics of speckle-tracking echocardiography (EchoCG) data in the 2DT mode, showed low informativeness of EF, proved the feasibility of calculating extremely relevant for the myocardium derivatives of force, time and speed with an assessment of the dynamics of myocardial fiber contraction in the longitudinal, circular and radial directions.

The aim of the study was to determine early markers of EF systolic dysfunction in pregnant women with preeclampsia without proteinuria according to speckle-tracking echocardiography.

#### **MATERIALS AND METHODS**

The study included 38 pregnant women with preeclampsia at the age of  $28.7 \pm 6.2$  years, who were observed in the maternity hospital of SamMU. Based on the anamnesis data (the presence of hypertension), the patients were divided into 2 groups: group 1 - 19 patients without a history of hypertension, group 2 – 19 patients with hypertension before pregnancy (within the range of hypertension 1 art. for 3 years before pregnancy). The distribution of patients into groups, taking into account age, gestation period, blood pressure figures, is shown in Table 1.

All the patients included in the study had sinus rhythm and the first pregnancy. The exclusion criterion was multiple pregnancies, in which the size of the acoustic window significantly worsened, which made it difficult to assess in the gray scale and 2DT mode.

The control group consisted of 19 pregnant patients a similar gestation period with normal systolic and pumping function of the heart, as well as normal indicators of the deformational properties of the myocardium. The data in the control group coincide with the data obtained from pregnant women by other researchers. In the monitoring mode, the heart rate (HR) was evaluated in 12 leads on the Schiller Cardiovit AT-1 device (Schiller Healthcare India Ltd).

Daily monitoring of heart rate and blood pressure was performed on a bifunctional monitor MEKG-DP-NS-01. Echo-KG was performed on Aplio Artida and Aplio 500 ultrasound scanners (Toshiba Medical System Corporation, Japan). Echo-KG was performed according to a generally accepted protocol with an assessment of the size of cavities, intracardiac hemodynamics, systolic and pumping function of the heart, with mandatory indexing of indicators. Global longitudinal (GLS), radial (GRS), and circular (GCS) systolic deformation



were evaluated in 2DT modes. . The parameters were analyzed using Wall Motion Tracking (WMT) software. The results of studying GLS, GCS, GRS were presented in the form of absolute values of parameters. Statistical analysis of the obtained results was performed using the 9.3 program (SAS institute Inc., Cary, NC). Descriptive statistics are presented as the proportion or average range of the likely deviation. Comparisons between groups were made using Chi-squared or Fisher's exact criterion for categorical variables and the Wilcoxon rank sum test for continuous variables. The differences were considered statistically significant at  $p < 0.05$ .

## RESULTS AND DISCUSSION

During our study, EchoCG was performed in 68 pregnant women with PE (the control group was recruited earlier), however, in 30 patients (not included in the analysis), it was not possible to adequately analyze the data in 2DT due to the low quality of the grayscale image. In this study, the parameters of myocardial deformation were not evaluated in the 3DT mode, which significantly shortened the study time, bringing it closer to comfortable for pregnant women.

Table 1. Characteristics of the examined patients

Parameter	1st group	2nd group	Differences with control	Control	Differences between groups
Age, years	28.4 ± 4.50	30.4 ± 5.7	-	-	-
Gestation period, weeks	36.7 ± 2.31	36.8 ± 2.30	-	-	-
SAP mmHg	127,3 ± 5,42	135,4 ± 4,88	1,2*	112 ± 3,90	-
DAP, mmHg	70,2 ± 4,38	86,2 ± 4,30	2*	69,9 ± 3,4	1-2*

Groups 1 and 2 did not significantly differ in age and gestation period (Table 1). There were also no differences in systolic blood pressure between the groups, however, patients with PE who were diagnosed with hypertension before pregnancy had higher diastolic blood pressure than in Group 1.

In terms of the volume of LV, EF and cardiac output (HF) there were no significant differences between the patients of the 1st and 2nd groups and the control group (Table 2), however, we assume that systolic myocardial dysfunction is present in all patients with PE, including at normal values of EF and normal pumping function of the heart. The indices of LV myocardial deformity obtained by us in healthy pregnant women (control group) did not differ from those of healthy non-pregnant patients.

Table 2. Instrumental data of patients and control groups

Parameter	1st group	2nd group	Differences with control	Control	Differences between groups
Final diastolic volume LV, ml	98,9 ± 11,82	97,5 ± 10,5	-	89 ± 12	-
Final systolic volume LV, ml	37,92 ± 6,22	37,4 ± 6,14	-	32 ± 8	-
EF LV, % -	63,5 ± 3,22	62,7 ± 3,26	-	65 ± 5	-
cardiac output l/min	4,48 = 0,54	4,30 = 0,70	-	4,6 = 0,62	-
GLS, %	-15,10 ± 1,4	-13,40 ± 1,50	2*	-17,0 ± 0,4	-
GCS, %	-24,01 ± 2,2	-23,40 ± 2,1	1,2*	-17,4 ± 0,5	-
GRS, %	33,6 ± 2,3	36,81 ± 1,22	2*	33,1 ± 1,4	-



GLS scores were significantly lower in women with PE on the background of pre-pregnancy hypertension compared with the control group, however, the 1st and 2<sup>nd</sup> groups did not differ significantly in terms of GLS ( $p = 0.04$ ). Compared with the control, the patients of the 2nd group showed an increase in GSM and GPS, and pregnant women Only an increase in GCS was noted in the 1st group. There were no significant differences between the groups based on the 2DT data.

The decrease in GLS indicators in group 2 is most likely a manifestation of a violation of early longitudinal relaxation of cardiomyocytes, while as the changes that were observed in the parameters of radial and circular deformation were compensatory in nature, however, it is problematic to obtain a complete picture (in fact, resultant forces) in the 2DT mode. For a deeper assessment, the global area analysis (in 3DT mode) may be useful, which was demonstrated by us in a parallel study, but the GAS assessment significantly increased the study time, which did not allow routine use GAS analysis in pregnant women, as opposed to 2DT parameters.

It should be noted that the analysis of cardiomyocyte movement in the 2DT (GLS) mode can serve as a tool for assessing latent systolic myocardial dysfunction LV during pregnancy, however, a short period of AH before pregnancy in combination with low blood pressure figures

(Group 2) did not allow to obtain reliable differences of this parameter between the 1st and 2nd groups.

## CONCLUSIONS

The systolic LV function in pregnant women with PE should be evaluated comprehensively, with the inclusion of speckle-tracking echocardiography parameters, which contributes to the detection of subclinical myocardial damage, despite the normal values of the ejection fraction, the absence of signs of myocardial remodeling and proteinuria. All patients with PE without proteinuria with hypertension detected before pregnancy to some extent have manifestations of latent systolic dysfunction of the LV myocardium. Changes in the deformational properties of the myocardium in patients with PE are most likely due to PE and are not a consequence of pregnancy.

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