International Journal of Innovative Research in Medical Science (IJIRMS)
Volume 04, Issue 02, February 2019,
https://doi.org/10.23958/ijirms/vol04-i02/561

Original research article

Echocardiographic Heart Changes in Pregnancies Complicated with Gestation Hypertension and Preeclampsia

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Received 22 January 2019; Accepted 10 February 2019; Published 14 February 2019

Abstract

Introduction: 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 gestational hypertension/preeclampsia. ***Aim:*** The aim of the study is to show that some of the heart changes in pregnancies complicated with gestational hypertension and preeclampsia are abnormal and further follow up of these patients is needed. ***Methods:*** A total of 81 patients were enrolled in the study. The patients were further divided in two groups. Pregnant women with gestational hypertension or preeclampsia (51) and a control group of normotensive pregnancies (30). A total of 3 echocardiograph exam were made, the first upon entry in the study (28 -34 g.w), the second 2 weeks after delivery and the last 6 months after delivery. ***Results and discussion:*** We found several statistically significant results that involve the IVS, PWLV, LKM, left chamber hypertrophy and diastolic function. Diastolic dysfunction usually shows up before systolic dysfunction in the evolution of ischemic/hypertensive cardiovascular disease and is of prognostic value in predicting long term cardiovascular morbidity. The changes seen 6 months after delivery on our last control mean that those changes are permanent and need further prevention strategies. ***Conclusion:*** From the noninvasive methods echocardiography is the most favorable method in identifying structural changes and functional changes in pregnancies with hypertension. Echocardiography allows fast, reproducible information and is both safe for mother and fetus.

Keyword: ***echocardiography, pregnancy, hypertension***

Introduction

Hypertensive disorders in pregnancies are seen in 6-10% of all pregnancies.[1] Hypertensive disorders that are associated with pregnancy are gestational hypertension and preeclamspia. In the last several years a link was established between heart abnormalities and gestational hypertension/preeclampsia.[2] 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 gestational hypertension/preeclampsia.[3]

Gestational hypertension occurs in pregnancies after the 20 week of gestation and involves blood pressure >140/90 without the presence of proteinuria.[4] Preeclampsia is a multifactorial disorder that manifests in pregnancy after the 20 week of gestation and involves proteinuria >300mg/L in 24 hour specimen and TA>140/90.[5] Hypertensive disorders in pregnancies are a big contributor in preterm deliveries. The incidence of preeclampsia has increased by 25% in the USA in the last two decades.[6] Untimely and inadequate treatment is seen throughout the world which influences the number of perinatal complications even death. Gestational hypertension and preeclampsia represent a risk for further cardiovascular disease and metabolic syndrome. Cardiovascular involvement in hypertensive disorders in pregnancy especially in preeclampsia is seen as increased heart afterload caused by hypertension and heart preload which negatively impact the physiological hypervolemia seen in pregnancies. The endothelial change in liquid transfer from intra into extracellular space can lead to pulmonary edema.

Hemodynamic changes which are seen in hypertension depend on the type of hypertension and its severity. In some pregnancies hemodynamic changes can be seen before the clinical manifestation of hypertension and preeclampsia.[7] When we want to measure the heart function in preeclampsia we need echocardiographic measurements of the myocardia and the clinical significant ventricular function.

Myocardial function, chamber remodeling and the dynamics of chamber preload can be noninvasively bechecked with echocardiography. Several techniques are being used: two dimensional and M mode echocardiography, pulse Doppler analyses (PDA), tissue Doppler analyses and some newer techniques in evaluation of chamber deformation. Recent studies have found that in pregnancies with gestational hypertension and preeclampsia chamber remodeling with consecutive diastolic dysfunction can be seen.[8] Some of the changes stated above can be seen in the healthy normal pregnancies but in patients with clinical signs of gestational hypertension or preeclampsia they still manifest 6 months after delivery.[9]

Women with normal pregnancy have normal chamber function. Pregnant women with hypertensive disorders in pregnancy have normal chamber systolic function but diastolic dysfunction is seen in large proportion of this patients.[3]

Aim

The aim of the study is to show that the heart changes in pregnancies complicated with gestational hypertension and preeclampsia are abnormal and further follow up of these patients is needed.

The research was done at the University Clinic for Gynecology and Obstetrics in Skopje, Macedonia. The design of the study was observational, longitude and prospective. The study was done between 01.01.2015 and 01.01.2017. Every woman filled in a signed consent upon entry the study. The study was authorized by the ethic committee at the Medical University in Skopje.

Patients and Methods

A total of 81 patients were enrolled in the study. The patients were further divided in two groups

- Pregnant women with gestational hypertension or preeclampsia(51)
- Control group of normotensive pregnancies(30)

Inclusion criteria

- Single pregnancy between 28 and 34 g.w
- Single pregnancy with clinical signs of gestational hypertension
- Single pregnancy with clinical signs of preeclampsia

Exclusion criteria

- Unknown gestational age
- Twins
- Previous cardiac history
- Diabetes
- Preexisting chronic disease

A total of 3 echocardiographic exam were made, the first upon entry in the study (28 -34 g.w), the second 2 weeks after delivery and the last 6 months after delivery. In all study participants a complete M- mode and two-dimensional study was done. Tissue Doppler analyses (TDA) and color Doppler was done.

In M-mode the following variables were evaluated: LVEDd, LVEDs, LA, IVS, Aoasc, LVPW, LA, DCDb, LKM, EF and FS. Measurements were done in compliance with current recommendation by the American association for echocardiography and the European society for echocardiography.

LKM was calculated with the formula by Deveraux according to ASE.

Increased LKM was >162 gr.

Diastolic function was calculated with pulse Doppler analyses of chamber filling presented with transmittal flow – profile speed. The following variables were evaluated

- E wave ,A wave ,E/A, mdt E wave

Left chamber diastolic dysfunction

1. Normal diastolic function
2. Abnormal relaxation
3. Pseudonormal type of diastolic dysfunction
4. Restrictive type of diastolic dysfunction

Results

Table 1: Echocardiographic characteristics in patients in evaluated and control group upon entry in the study

Parameter	Evaluated group	Control group	P
LVEDd1(CB*±SD)	48,98±3,73	47,37±2,74	0,04‡
LVEDs1(CB*±SD)	31,16±3,11	29,13±2,71	0,004‡
EF1(CB*±SD)	64,86±4.,27	67,03±4,45	0,03‡
FS1(CB*±SD)	35,51±3,57	36,78±7,49	0,3‡
DVDb1(CB*±SD)	26,94±3,29	26,87±1,83	0,9‡
LA1(CB*±SD)	34,59±3,74	31,10±2,55	<0,001‡
AOasc1(CB*±SD)	30,00±2,65	28,93±1,57	0,05‡
IVS1(CB*±SD)	11,67±1,03	10,50±0,68	<0,001‡
PWLV1(CB*±SD)	9,37±0,94	8,50±0,57	<0,001‡
LKM1(CB*±SD)	190,25±34,63	156,03±18,11	<0,001‡
Left chamber hypertrophy			<0,001†
No (n, %)	35 (68,6%)	30 (100%)	
Yes (n, %)	16 (31,4%)	0	
Diastolic dysfunction			<0,001†
No (n, %)	29 (56,9%)	29 (96,7%)	
Yes (n, %)	22 (43,1%)	1 (3,3%)	

**AV – average value; †Chi-square test; ‡Student's t-test*

Table 2: Parameters of diastolic function evaluated with PDA and TDA in evaluated and control group

	Evaluated group (n=51)	Control group (n=30)	P
E wave, m/s	0.67±0.04	0.78±0.02	< 0.005‡
A wave, m/s	0.62±0.12	0.57±0.04	0.05‡
DT, ms	215.1±16.8	191±4.8	< 0.005‡
E/A ratio	1.08±0.23	1.5±0.07	<0.01‡
E', cm/s	8.3±1.9	9.4±0.8	<0.05‡
E/E' tario	9.9±2.0	8.2±0.5	< 0.05‡
LP, mm	34.6±3.7	28.9±1.6	<0.001‡

‡Student's t-test

Table 3: Diastolic function in evaluated and control group upon entry in the study

	Evaluated group (n=51)	Control group (n=30)	P
Distolic dysfunction			
No (n, %)	29(56.9%)	29 (96.7%)	<0.001†
Yes (n, %)	22(43.1%)	1(3.3%)	
Delayed relaxation	19 (37.2%)	1 (3.3%)	
Pseudonormal type	3 (5.9%)	0	
Restricitve type	0	0	

†Chi-square test

Table 4: Echocardiographic characteristics in patients in evaluated and control group 2 weeks postpartum (second control)

Parameter	Evaluated group	Control group	P
LVEDd2 (CB*±SD)	49,29±3,83	48,53±3,76	0,39‡
LVEDs2 (CB*±SD)	32,45±5,42	29,33±2,88	0,005‡
EF2 (CB*±SD)	63,82±6,26	67,40±3,45	0,005‡
FS2 (CB*±SD)	36,02±3,71	37,60±2,95	0,05‡
DVDb2 (CB*±SD)	27,94±3,08	26,33±2,38	0,02‡
LA2 (CB*±SD)	30,35±2,23	30,23±2,40	0,82‡
AOasc2 (CB*±SD)	32,80±5,84	30,40±2,84	0,04‡
IVS2 (CB*±SD)	11,37±0,96	10,27±0,64	<0,001‡
PWLV2 (CB*±SD)	9,55±0,94	8,47±0,57	<0,001‡
LKM2 (CB*±SD)	191,08±41,19	159,87±24,74	<0,001‡
Left chamber hypertrophy			0,01†
No (n, %)	42 (82,4%)	30 (100%)	
Yes (n, %)	9 (17,6%)	0	
Diastolic dysfunction			<0,001†
No (n, %)	34 (66,7%)	30 (100%)	
Yes (n, %)	17 (33,3%)	0	

Chi-square test; ‡Student's t-test

Table 5: Parameters of diastolic function evaluated with PDA and TDA in evaluated and control group two weeks postpartum (second control)

	Evaluated group (n=51)	Control group (n=30)	P
E wave, m/s	0.67±0.04	0.77±0.02	< 0.05‡
A wave, m/s	0.60±0.12	0.57±0.06	0.06‡
DT, ms	208.3±18.8	196.5±5.3	< 0.005‡
E/A ratio	1.28±0.23	1.52±0.07	<0.01‡
E', cm/s	8.7±1.6	9.6±0.7	<0.05‡
E/E' ratio	9.0±2.2	7.8±0.6	< 0.05‡
LP, mm	33.5±4.1	28.9±1.6	<0.001‡

‡Student's t-test

Table 6: Diastolic function in evaluated and control group two weeks postpartum (second control)

	Evaluated group (n=51)	Control group (n=30)	P
Diastolic dysfunction			
No (n, %)	34(66.7%)	30 (100%)	<0.001†
Yes (n, %)	17(33.3%)	0	
Delayed relaxation	17 (33.2%)	0	
Pseudo normal type	0	0	
Restrictive type	0	0	

†Chi-square test

Table 7: Echocardiographic characteristics in patients in evaluated and control group 6 months postpartum (third control)

Параметар	Evaluated group	Control group	P
LVEDd3 (CB*±SD)	49.06±3.89	48.00±2.64	0.15‡
LVEDs3 (CB*±SD)	30.55±3.70	30.93±2.82	0.63‡
EF3 (CB*±SD)	66.51±3.68	67.20±2.64	0.37‡
FS3 (CB*±SD)	38.22±4.75	37.77±4.83	0.68‡
DVDb3 (CB*±SD)	27.75±2.88	27.27±2.82	0.47‡
LA3 (CB*±SD)	30.75±3.12	29.67±1.71	0.05‡
Aoasc3 (CB*±SD)	33.63±2.80	31.73±2.91	0.005‡
IVS3 (CB*±SD)	10.63±1.02	9.77±0.77	<0.001‡
PWLV3 (CB*±SD)	8.67±0.93	8.17±0.38	<0.001‡
LKM3 (CB*±SD)	162.39±33.77	147.57±17.76	<0.001‡
Left chamber hypertrophy			0.02†
Yes (n, %)	35 (81.3%)	26 (100%)	
No (n, %)	8 (18.7%)	0	

†Chi-square test; ‡Student's t-test

Table 8: Parameters of diastolic function evaluated with PDA and TDA in evaluated and control group6 months postpartum (third control)

	Evaluated group (n=43)	Control group (n=26)	P
E wave, m/s	0.72±0.04	0.78±0.02	< 0.05‡
A wave, m/s	0.59±0.12	0.56±0.14	0.06‡
DT, ms	210.3±18.8	194.5±4.7	< 0.05‡
E/A ratio	1.32±0.23	1.57±0.05	<0.05‡
E', cm/s	8.8±1.7	9.5±0.9	0.05‡
E/E' ratio	8.6±2.5	7.6±0.6	< 0.05‡
LP, mm	30.75±3.12	29.67±1.71	0.05‡

‡Student's t-test

Table 9: Diastolic function in evaluated and control group 6 months postpartum (third control control)

	Evaluated group (n=43)	Control group (n=26)	P
Diastolic dysfunction			
No (n, %)	31(71.9%)	26 (100%)	0.003†
Yes (n, %)	12 (28.1%)	0	
Delayed relaxation	12 (28.1%)	0	
Pseudo normal type	0	0	
Restrictive type	0	0	

†Chi-square test

Discussion

In our study heart function was systematically followed through the pregnancy and 6 months postpartum. The idea to have a close follow up after delivery arises because we expect heart normalization 3 months postpartum. The changes seen 6 months after delivery that is on our last control mean that those changes are permanent and the need for further prevention. One set back was that 8 patients from the evaluated group and 4 patients from the control group failed to finish the last control.

When we reviewed our data, we found several statistically significant results that involve the IVS, PWLV, LKM, left chamber hypertrophy and diastolic function.

IVS is one of the main signs that show persistent heart changes. When comparing the control with evaluated group we got a statistically high significance p<0. 001. The increase in the IVS goes towards a chronic process and its high value is a sure sign of Left ventricular hypotrophy and increased muscle mass. Increased IVS values were found in Melchiore,[2,9] and Valensise.[10] According to Novelli[11] the value of IVS e proportional to the severity of gestational hypertension/preeclampsia and how long the disease last.

Statistical significance was found when comparing PWLV in evaluated with control group of p<0.001. The changes seen on the posterior wall of the left chamber are directly linked with IVS, LVEDd when calculating for LVM. Conclusive results like ours were seen in the studies by Melchiore[2,9] and Valensise.[10]

The results of the LVM in the evaluated group were 190, 25 grcompared to the control group of 156 gr (p<0.001). Our results were confirmed by Novelli.[12] Further confirmation was found in the study by Simmons[13] were they evaluated preeclamptic, control pregnancies and normal nonpregnant population. LVM was increased in preeclamptic woman. In the study by Kim[14] comparison was made between normotensive and gestational hypertension. Significant increase p<0.001 was found in LVM in gestational hypertension group. Gestational hypertension and normotensive group was researched by Novelli[11] how found LVM increase in the gestational hypertension group.

Left chamber hypertrophy is an important factor in left chamber remodeling. Numerous remodeling models exists, such as concentric remodeling, eccentric hypertrophy, concentric hypertrophy. In most studies LV hypertrophy is seen in gestational hypertension compared to controls in second and third trimester of pregnancy.[15] In some studies, no confirmation of LV hypertrophy was found showing that it is the result of chronic hypertension.[16]

In our study LV hypertrophy was seen in 31% of the evaluated hypertensive group upon entry in the study, 18,4% in the second control and 18,7% on our last control. It is also worth mention again that 12 participants failed to finish the last control (6 months postpartum).

LV hypertrophy is usually concentric[17] and occurs in preterm preeclampsia.[18,19,20]

Diastolic dysfunction is defined as inability of the heart to fill up with normal volume with increase in filling pressure. In the study we found one patient in the control group with diastolic dysfunction which normalized in the next control. In the hypertensive group diastolic dysfunction was seen in 43,1% of the evaluated group at the entry in the study,33,3% on the second control 2 weeks postpartum and 28,1% on the last control 6 months after delivery. Because of the small number of patients we did not distinguish between preterm preeclampsia<37 g.wand term preeclampsia >37 g.w. Diastolic dysfunction was seen in more than 50% of case in early onset preeclampsia Melchiore[9] on the first control. One year after delivery diastolic dysfunction was seen in 14% of term preeclampsia compared to 40% in preterm preeclampsia. According to Simmons[13] changes that persist 1 year postpartum have severe cardiovascular consequences.

Diastolic dysfunction usually shows up before systolic dysfunction in the evolution of ischemic/hypertensive cardiovascular disease and is of prognostic value in predicting long term cardiovascular morbidity.[21]

Conclusion

Pregnancy is a complex process involving the whole organism. Physiological heart changes occur in every pregnancy .Pregnancy is considered as a stress test for the normal organism. Both gestational hypertension and preeclampsia are associated with maternal and fetal morbidity and are a leading cause of maternal death. They both influence the structure and function of the heart. From the noninvasive methods echocardiography is the most favorable method in identifying structural changes and functional changes in pregnancies with hypertension.

Echocardiography allows fast, reproducible information and is both safe for mother and fetus. These study has shown that during pregnancy and postpartum there are changes in the heart function as a result of hypertension. Increase LVM (hypertrophy), diastolic dysfunction and abnormal muscle relaxation are the main changes seen. In pregnancies with preeclampsia, diastolic function, increased peripheral resistance and remodeling of the chamber correlate with the severity of preeclampsia and are useful clinical indicator for bad perinatal outcome and in the long run future cardiovascular health.

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