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Role of trans-thoracic echocardiography in a comparative assessment of left ventricular systolic and diastolic function in the third trimester of pregnancy with pre-eclampsia and normotensive pregnancy

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Abstract

Objective: This study was done to determine maternal left ventricular systolic and diastolic function using echocardiography in normal and preeclamptic women in the third trimester of pregnancy.

Materials and Methods: This cross-sectional study was conducted at the Department of Obstetrics and Gynecology, SMS Medical College, Jaipur from March 2018 to December 2018. Two dimensional transthoracic echocardiography was performed in 50 pregnant women with preeclampsia (Group I) and 50 normotensive pregnant women (Group II) after applying inclusion and exclusion criteria. Baseline characteristics and maternal systolic and diastolic parameters assessed on echocardiography.

Results: On comparision of systolic parameters we found **SV** (ml) values in the preeclamptic group and in the normotensive group were 61±11.64 and 48.80±6.422 respectively, which is statistically significant.CO in the preeclamptic group was 6.69±1.34 L/min as compared to 5.51±0.75 L/min in the normotensive group. This observation was statistically significant. LV ESV, LV EDV, ARD and LVOT were increased in the preeclampsia group but there was no statistically significant difference between the groups.

On comparison of diastolic parameters we found, E-wave velocity values in the preeclamptic group and in the normotensive group were 0.95±0.36 m/sec and 0.59±0.22 m/sec respectively, which is statistically significant. Peak A-wave velocity in the preeclamptic group was 0.68±0.284 m/sec and as compared to 0.47±0.186 m/sec in the normotensive group .This observation was statistically significant. E/A ratio and IVRT (msec) also found significantly increased in preeclamptic group. A VTI (msec) and E VTI (msec) both were higher in the preeclampsia group. But this difference was not statistically significant between the groups.

Student's *t*-test was used as a test of significance.

Conclusion: Women with preeclampsia in the third trimester have significantly systolic and diastolic left ventricular dysfunction compared to normotensive controls. Blood pressure (BP) monitoring alone is

insufficient to effectively identify the risk of cardiovascular complications
in these subjects. Echocardiography is a quick, noninvasive method to evaluate the maternal hemodynamics. Thus routine echocardiographic assessment protocol for preeclamptic women would help to improve long term outcomes.

Keywords: maternal, normal, preeclampsia, systolic, Diastolic, echocardiography.

Introduction

Preeclampsia is a pregnancy specific syndrome that can affect virtually every organ system.it heralds a higher incidence of cardiovascular disease later in life.[1] It is defined as blood pressure greater than 140/90 mmHg 4 hours apart associated with proteinuria greater than 0.3 gm/dl in a 24 hours urine collection or greater than 1 gm/L or ≥ +1 on urine dipstick examination.[1] Women with preeclampsia have diverse haemodynamic findings such as increased cardiac output, high vascular resistance and decreased myocardial contractility.[2] Acute preeclampsia is associated with a significantly higher prevalence of asymptomatic abnormal left ventricular function and myocardial injury.[3] Preeclampsia is also associated with high risk of subsequent heart failure, ischemic and hypertensive heart diseases, and related mortality compared with uneventful pregnancy in later life.[4,5] There is an increasing understanding that cardiovascular diseases are generally progressive disorders that proceed through asymptomatic to symptomatic stages.[6] Therapeutic intervention during the asymptomatic phase of cardiac derangement can improve the long term prognosis more effectively than when commenced at the symptomatic stage.

Current clinical diagnostic and monitoring tools for assessing the cardiovascular system are limited in pregnancy to blood pressure, electrocardiography (ECG), pulse oximetry and rarely invasive pulmonary artery pressure or cardiac output monitoring. Invasive monitoring devices such as pulmonary artery catheter are currently rarely used as research tools. Transthoracic echocardiography, however, routinely used in cardiovascular system research in other areas of medicine. It is frequently considered reference standard for cardiovascular system monitoring .it is non invasive, quick, simple, precise and is validated in pregnancy. It is an ideal device for measuring the cardiac function in women with preeclampsia however is currently rarely used for this purpose.

Materials and Methods

Study design: hospital based analytical type cross sectional study.

Sample size:-This study was carried out at the Department of Obstetrics and Gynecology, SMS Medical College, Jaipur from March 2018 to December 2018. One hundred (100) subjects were enrolled, of whom 50 were pregnant women with preeclampsia (Group I) and 50 were normotensive pregnant women (Group II).

For **inclusion criteria** gestational age ≥ 34 weeks and singleton pregnancy were taken. Each woman underwent echocardiography and hemodynamic studies. Written informed consent was obtained from all the participants. The predetermined **exclusion criteria** for the study were: gestational age less than 34 weeks, Diabetes, known maternal cardiovascular disease, alcohol use, and tobacco use, multiple gestations, severe anemia and chronic obstructive pulmonary disease. Gestation was confirmed by last menstrual period and ultrasound measurement in the first trimester. BP was measured using the standard auscultatory method with the help of a pneumatically

operated mercurial type sphygmomanometer. BP was measured in the left arm in the sitting position with the arm at the level of the heart. While recording BP, the appearance of sound (Phase I Korotkoff) and disappearance of sound (Phase V) were recorded as systolic and diastolic BP respectively.

Echocardiography

All women were studied by using standard two dimensional and Doppler transthoracic echocardiography. Hemodynamic measurement was carried out in the left lateral recumbent position after at least 5 min of rest. Echocardiographic examination was performed using PHILIPS I.E. 33 MATRIX echocardiograph machine by the same senior cardiologist to avoid inter observer variation. M-mode studies were performed at the level of the aorta, left atrium and left ventricle at midposition between the tips of the mitral valves and papillary muscles. Pulsed doppler flow across the mitral valves were recorded to obtain the left ventricular diastolic filling pattern. Systolic parameters studied were left ventricle end systolic volume (LV ESV), left ventricle end diastolic volume (LV EDV), stroke volume (SV), cardiac output (CO),aortic root diameter (ARD) and left ventricular outflow tract (LVOT). Diastolic parameters studied were E wave, A wave, E/A ratio, isovolumetric relaxation time (IVRT), E wave velocity time integral (E VTI) and A wave velocity time integral (A VTI).

Statistical analysis

In this study, data were shown as mean ± standard deviation (SD). Analysis of variance (ANOVA) was used to compare data between normotensive pregnant and preeclamptic groups. Student's *t*-test was used as a test of significance. The probability value ($P < 0.05$) is described as significant.

Results

Table:1 Demographic Characteristics Of Two Groups

Parameters	Group I Preeclamptic (n = 50) Mean± standard deviation	Group II Normotensive (n = 50) Mean± standard deviation	P value (NS-not significant)
Age (years)	25.06±1.21	24.13±1.70	0.62, NS
Body mass index (kg/m^2)	23.52±1.86	22.96±2.11	0.39, NS
Body surface area (m^2)	1.81±.034	1.78±0.06	0.09,NS

$P > 0.05$ = Not Significant (NS); *$P < 0.05$ = Significant; **$P < 0.01$ = Highly significant;

***$P < 0.001$ = Very highly significant

Table 2: Comparison Of Systolic Parameters Between Two Groups

Parameters	Group I Preeclamptic (*n* = 50) Mean± standard deviation	Group II Normotensive (*n* = 50) Mean± standard deviation	*P* value (NS-not significant)
LVEDV(ml)	101.89±16.18	98.70±4.03	0.327 NS
LVESV(ml)	35.05±9.92	31.26±5.87	0.062 NS
SV(ml)	61±11.64	48.80±6.422	‹ 0.001 ,Sig.

CO (L/min)	6.69±1.34	5.51±0.75	‹0.05, Sig
ARD(cm)	2.36±0.47	2.17±0.59	0.572 NS
LVOT(cm)	1.99±0.46	1.87±0.43	0.451 NS

P > 0.05 = Not Significant (NS); **P* < 0.05 = Significant; ***P* < 0.01 = Highly significant; ****P* < 0.001 = Very highly signifycant; LV ESV = Left ventricular end systolic volume; LV EDV = Left ventricular end diastolic volume; SV = Stroke volume; CO = Cardiac output; ARD= Aortic Root Diameter; LVOT= Left Ventricular Outflow Tract

Table 3: Comparison Of Diastolic Parameters Between Two Groups

Parameters	Group I Preeclamptic (n = 50) Mean± standard deviation	Group II Normotensive (n = 50) Mean± standard deviation	P value (NS-not significant)
E Wave velocity (m/s)	0.95±0.36	0.59±0.22	‹ 0.001, Sig.
A Wave velocity (m/s)	0.68±0.284	0.47±0.186	0.003, Sig.
E/A ratio	1.37±0.168	1.27±0.117	0.024, Sig.
IVRT (msec)	81.63±7.62	76.83±6.17	0.02, Sig.
A VTI(msec)	5.525±1.73	4.87±2.354	0.27 NS
E VTI(msec)	12.25±2.517	13.836±1.386	0.55 NS

P > 0.05 = Not signifi cant (NS); **P* <0.05 = Signifi cant; ***P* < 0.01 = Highly

signifi cant; ****P* < 0.001 = Very highly signifi cant; IVRT =, isovolumetric relaxation time; E VTI= E wave velocity time integral; A VTI= A wave velocity time integral

Table 1 shows the demographic characteristics of the study population. Age, body mass index and body surface area (BSA) were similar in the two groups. Mean age, BMI and body surface area were high in the preeclamptic group but there were no statistically significant differences between the groups.

Table 2 shows a comparison of systolic parameters between two study groups. SV (ml) values in the preeclamptic group and in the normotensive group were 61±11.64 and 48.80±6.422 respectively, which is statistically significant, P value ‹ 0.001. CO in the preeclamptic group was 6.69±1.34 L/min as compared to 5.51±0.75 L/min in the normotensive group. This observation was statistically significant at *P value* < 0.05. LV ESV, LV EDV,ARD and LVOT were increased in the preeclampsia group but there was no statistically significant difference between the groups.

Table 3 shows a comparison of diastolic parameters between normotensive and preeclamptic subjects.E-wave velocity values in the preeclamptic group and the normotensive group were 0.95±0.36 m/sec and 0.59±0.22 m/sec respectively, which is statistically significant P value ‹ 0.001. Peak A-wave velocity in the preeclamptic group was 0.68±0.284 m/sec and as compared to 0.47±0.186 m/sec in the normotensive group .This observation was statistically significant at *P value* 0.003. E/A ratio and IVRT (msec) also found significantly increased in the preeclamptic group with P value 0.024 and 0.02 respectively. A VTI (msec) and E VTI (msec) both were higher in the preeclampsia group. But this difference was not statistically significant between the groups.

Discussion

Association between preeclampsia and cardiovascular morbidity has been highlighted in various studies.[7,8] Acute cardiovascular complications occur in around 6% of patients with severe preeclampsia.[8]

Cardiac dysfunction, both systolic and diastolic is known to occur in hypertension. Diastolic dysfunction usually precedes systolic dysfunction and can lead to heart failure or pulmonary edema.[9] If this cardiovascular dysfunction can be picked by echocardiography in preeclamptic women, it may be possible to reduce the risk of heart failure by early intervention.

In this small and preliminary study, we have assessed the role of echocardiography and found it to be a useful technique for evaluation of maternal cardiac function in preeclamptic women. This study confirms earlier studies that there were physiological changes in left ventricle structure and function during normal pregnancy but that exaggerated physiological changes were seen in pregnant women with preeclampsia in the second trimester.

LVEDV and LVESV were increased in preeclamptic group ,these results were comparable to the study done by Dennis AT et al[10] and Chahinda GD et al [11] in which they studied the cardiovascular hemodynamics in preeclamptic and normotensive pregnant women,they found statistically significant difference in mean of LVEDV and LVESV between the two groups highlighting the importance of these variables in early detection of cardiovascular morbidity. In our study CO and SV increased significantly in preeclamptic subjects; this confirms earlier studies by Vasapollo *et al.*[12] There is a physiological increase in SV during normal pregnancy but this is exaggregated in preeclamptic pregnancy. Increased end diastolic volume increases preload subsequently leads to an increased stroke volume as per frank- starling law. Cong J et al[13] also found significantly higher SV in the preeclamptic group as compared to the normotensive group. High cardiac output in preeclamptic women is due to increased SV and increased heart rate as compared to the control group. Increased ARD in preeclamptic women corresponds to increased SV against increased after load (total vascular resistance). In our study cardiac diastolic parameters E Wave velocity, A wave velocity and E/A ratio were significantly higher in the preeclamptic group, similar results were obtained by Solanki R et al (2011)[8].

Tanuja Muthyala et al.[14] studied Maternal Cardiac Diastolic Dysfunction in Women with Preeclampsia and found cardiac diastolic dysfunction occurred in one-fifth of women with preeclampsia. Grade of diastolic dysfunction correlated with the severity of preeclampsia. High E wave velocity in pre-eclamptic subjects suggests that the transmitral pressure gradient during early passive filling is greater and is due to changes in compliance of hypertrophied ventricle. Increased A wave velocity suggests increased atrial contribution during late ventricular filling reflecting increased level of ventricular diastolic dysfunction and elevated left ventricular end diastolic pressure, which may be the cause for increased symptoms of shortness of breath in preeclamptic patients.

One limitation of this study is that it was not possible to follow up subjects in the postpartumperiod to examine whether the altered cardiovascular hemodynamic state reverted to normal after pregnancy.

Conclusion

Preeclampsia is associated with left ventricular dysfunction which is a major risk factor in the pathophysiology of cardiovascular disease in later life.

It appears that BP monitoring alone is insufficient to effectively identify the risk of cardiovascular complications in these subjects. Thus routine echocardiography assessment protocol for preeclamptic women would help to improve long term outcomes.

References

1. 25th edition Williams Obstetrics Mac Graw Hill :40 (1087-1088)
2. Brown MC, Best KE, Pearce MS, Waugh J, Robson SC, Bell R. Cardiovascular disease risk in women with preeclampsia : systemic review and meta-analysis. Eur J epidemiol, 2013 Jan; 28(1): 1-19
3. Melchiorre K, Sutherland GR, Baltabaeva A, Liberati M, Thilaganathan B. Maternal cardiac dysfunction and remodeling in women with preeclampsia at term. Hypertension,2011;57:85-93.
4. Lykke JA, Langhoff-Roos J, Sibai BM, et al. Hypertensive pregnancy disorders and subsequent cardiovascular morbidity and type 2 diabetes mellitus in the mother. Hypertension. 2009;53:944–951.
5. Mongraw-Chaffin ML, Cirillo PM, Cohn BA. Preeclampsia and cardiovascular disease death: prospective evidence from the child health and development studies cohort. Hypertension. 2010;56:166–171.
6. Kuznetsova T, Herbots L, Jin Y, Stolarz-Skrzypek K, Staessen JA. Systolic and diastolic left ventricular dysfunction: from risk factors to overt heart failure. Expert Rev Cardiovasc Ther ,2010;8:251-258.
7. Melchiorre K, Thilaganathan B. Maternal cardiac function in preeclampsia. *Curr Opin Obstet Gynecol*. 2011; 23:440-47.
8. Solanki R, Maitra N. Echocardiographic assessment of cardiovascular haemodynamics in preeclampsia. *J Obstet Gynaecol India*. 2011;61:519-22.
9. Tangeda P, Shastri N. Maternal left ventricular systolic and diastolic function during second trimester of pregnancy with preeclampsia. *Journal of Dr. NTR University of Health Sciences*. 2015;4:224-28.
10. Dennis AT, Castro S, Carrc C, et al. Haemodynamics in women with untreated preeclampsia. Anaesthesia. 2012;67(10):1105–1118.
11. Chahinda GD, Louis P, Sanne VH, Sander VK, Julia S, Tammo D, Marc S. Hypertension after preeclampsia is preceded by changes in cardiac structure and function. Hypertension,2013;62(2):382-390.
12. Vasapollo B, Novelli GP, Valensise H. Total vascular resistance and left ventricular morphology as screening tools for complications in pregnancy. Hypertension 2008;51:1020-6.
13. Cong J, Fan T, Yang X, Squires JW, Cheng G, Zhang L and Zhang Z. Structural and functional changes in maternal left ventricle during pregnancy: a three dimensional speckle-tracking echocardiography study. Cardiovascular ultrasound, 2015;13:6.
14. Tanuja Muthyala et al., Assessment of Maternal Cardiac Diastolic Dysfunction by Doppler Echocardiography in Women with Preeclampsia; Journal of Clinical and Diagnostic Research. 2016 Aug, Vol-10(8): QC01-QC03