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ORIGINAL ARTICLE

A STUDY ON LEFT VENTRICULAR DIASTOLIC FUNCTION IN PREGNANT PATIENTS WITH PRE-ECLAMPSIA

[*1]Dr. J. Princy emil Josephine, [2]Dr. K. Latha, [3]Dr. N. Chidambaram and [4]Dr. E. Balasubramaniyan

[*1]Junior Resident, Department of Obstetrics and Gynaecology, Rajah Muthiah Medical College and Hospital, Chidambaram
[2]Professor of Obstetrics and Gynaecology, Department of Obstetrics and Gynaecology, Rajah Muthiah Medical College and Hospital, Chidambaram
[3]Professor of Medicine ,Department of General Medicine, Rajah Muthiah Medical College and Hospital,Chidambaram
[4]Senior Resident, Department of General Medicine, Rajah Muthiah Medical College and Hospital,Chidambaram

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ABSTRACT

Pre-eclampsia is a multisystem disorder of unknown etiology. It complicates 7-10% of all pregnancies. Cross – sectional studies of women with pre-eclampsia have revealed diverse hemodynamic findings such as elevated cardiac output, high vascular resistance and reduced cardiac output and reduced myocardial contractility. The data on changes in left ventricular diastolic function is scarce. In addition, there is conflicting information about left ventricular performance both during normotensive and hypertensive pregnancy. Normal, increased and depressed function have all been reported at various stages of gestation. This exploratory study was undertaken to assess the cardiovascular hemodynamic alterations in pre-eclampsia by echo cardiography and its impact on maternal and fetal outcome.**Methodology.**This prospective study was carried in Rajah Muthiah Medical College and Hospital, Chidambaram. Forty subjects were enrolled of which 20 had pre-eclampsia and 20 were normotensive. All were subjected to echocardiography. **Results:**In our results, diastolic dysfunction was described in the pre-eclamptic patients through prolonged isovolumetric relaxation time and E/A ratio reversal.

Keywords: Pre-eclampsia, diastolic dysfunction, Echocardiography, IVRT, E/A ratio.

1.INTRODUCTION

Pregnancy is characterised by a number of important hemodynamic changes. Blood volume increases by about 50%. The red cell mass increases by about 40%. The resting pulse rate increases by about 10 to 15 beats per minute. Cardiac output increases beginning in early pregnancy around 5th week and continues to increase and reaches its peak between the middle of 2nd and 3rd trimesters and remains elevated during the remainder of pregnancy(Blanco,2001).

Systemic arterial pressure begins to fall during the first trimester, reaches a nadir in midpregnancy and returns to pre-gestational level before term. The pulse pressure widens as the fall of diastolic pressure is greater than the fall of systolic pressure. The reduction in blood pressure results from a decline in systemic vascular resistance that occurs during pregnancy. These changes are largely physiological in normal pregnancies(Katz et al., 1978). But these changes are critical in patients with preeclampsia. Many studies have addressed the issues in relation to cardiac output, systemic vascular resistance, left ventricular stroke volume and pulmonary capillary wedge pressure.

It is also been speculated that associated subclinical left ventricular dysfunction may contribute to cardiac mortality and morbidity (Geva et al., 1997). There are only few data available regarding left ventricular function in pregnancy. So this prospective study on left ventricular systolic and diastolic function by echocardiography was undertaken in normal and preeclamptic pregnancies.

Corresponding author*: ***Dr. J. Princy emil Josephine,* *[1]Junior Resident, Department of Obstetrics and Gynaecology, Rajah Muthiah Medical College and Hospital, Chidambaram*

2.METHODOLOGY

This study was conducted in Rajah Muthiah Medical College and Hospital during the period of September 2015 to September 2016. This is a hospital based prospective study. The study protocol was approved by the institution's ethical committee. 20 pregnant women diagnosed as preeclampsia (as defined by BP ≥ 140/90nnHg associated with proteinuria of ≥ 1 + dipstick) and 20 pregnant normotensive women were prospectively studied by echocardiography. Blood pressure was measured in left arm in sitting position at the level of heart. Subjects with previously history of essential hypertension or other medical disorders complicating pregnancy were not included in this study. Both primigravida and multigravida wee included in this study.

3.OBSERVATIONS AND RESULTS

Table – 1 Average blood pressure readings in comparison groups

Groups	Systolic Blood Pressure		Diastolic Blood Pressure	
	Mean	SD	Mean	SD
I	144.00	8.208	95.00	6.070
II	114.00	7.539	74.00	6.806
t-test Result	**15.630**		**10.299**	
'P' Value	**<.001**		**<.001**	

Table 1 shows the distribution of Group I and Group II patients according to average blood pressure measurements. In this study, the mean systolic BP in Group I is 144.00 mmHg, Group II is 114.00 mmHg with 't' value of 15.630 mmHg. The mean diastolic blood pressure in Group I is 95.00 mmHg, Group II is 74.00 mmHg with 't' value of 10.299 mmHg. The difference in the systolic blood pressure and diastolic blood pressure between Group I versus Group II was statistically significant (P<0.001).

Table – 2 Pulse pressure and mean arterial pressure in comparison groups

Groups	Pulse Pressure		Mean Arterial Pressure	
	Mean	SD	Mean	SD
I	52.52	26.291	112.04	6.204
II	40.00	5.620	87.8315	6.60328
t-test Result	**2.098**		**11.960**	
'P' Value	**<.001**		**<.001**	

Table 2 shows the distribution of Group I and Group II patients according to pulse pressure and mean arterial pressure. In this study, the pulse pressure in Group I in 52.52, Group II is 40.00 with 't' value of 2.098. The mean arterial pressure in Group I is 112.04, Group II is 87.8315. The difference in the pulse pressure and mean arterial pressure between Group I versus Group II was statistically significant (P<0.001).

Table - 3 Distribution of group I and group II patients according to mode of delivery

Mode of Delivery	Group I		Group II		Chi-Square Value	P Value
	No.	%	No.	%		
Normal	5	25.0	9	45.0	1.758	0.184
LSCS	15	75.0	11	55.0		8

Table 3 shows the distribution of mode of delivery in Group I and Group II. In our study 25% of Group I patients had normal vaginal devilry where as 45% of Group II patients had normal vaginal delivery.

In Group I 75% of patients underwent LSCS where as 55% in Group II had LSCS. Hence Group I patients had more operative deliveries compared to Group II.

Table - 4 Mean and standard deviation of the variables for fetal outcome in two grous

Variables	Group I		Group II		'T' Value	'P' value
	No.	%	No.	%		
Birth weight	2.544	0.8329	2.9425	0.1062	2.980	<0.0001

Table 4 shows mean and standard deviation of the variable for fetal outcome in Group I and Group II.
The mean birth weight for Group I babies was 2.544 kgs but for Group II 2.94 kgs. The 't' value was 2.980 and was statistically significant (P<0.0001).

Table – 5 Distribution of babies admitted in NICU in both the groups

Groups	Admission in NICU		Not admitted in NICU		Chi-square value	'P' Value
	No.	%	No.	%		
I	13	65	6	30	14.05	<0.0001
II	2	10	18	90		

Table 5 shows the distribution of babies who got admitted in NICU in groups I & II. About 65% of babies of Group I mothers were admitted in NICU whereas only 10% of babies of Group II mothers were admitted in NICU.
The difference in both the groups were statistically significant at (P<0.001).

Table – 6 Mean and standard deviation for E/A ratio in group I, II

Variables	Group I		Group II		't' value	'p' Value
	Mean	SD	Mean	SD		
E/A Ratio	1.280	0.4021	1.605	0.1191	3.130	0.001

Table 6 shows the mean and standard deviation for E/A Ratio in the two groups of comparison.

The mean E/A Ratio in Group II is 1.605, Group I is 1.280. The 't' value was 3.130 and was statistically significant between Group I Vs Group II (P<0.001).

Table – 7 Mean and standard deviation for IVRT in group I, II

	Group I		Group II		't' value	'p' Value
	Mean	SD	Mean	SD		
IVRT	91.40	25.130	73.20	9.134	3.112	0.001

Table 7 shows the mean and standard deviation for IVRT in the two groups of comparison.

The mean IVRT in Group I is 91.40, Group II is 73.20. The 't' value was 3.112 and was statistically significant between Group I Vs Group II (P<0.001).

Table 8 Distribution of Group I and Group II Patients According to Diastolic Dysfunction

Groups	Early diastolic dysfunction	Normal diastolic function
Group I	4	16
Group II	0	20

Calculated chi-square value	Degrees of freedom	P Value	Significant
4.444	1	0.0350	Significant

The calculated chi-square value is 4.444 and the P-value was 0.0350. The chi-square test infers that the diastolic dysfunction in both groups were statistically significant.

The difference in the diastolic dysfunction between Group I versus Group II was statistically significant (P<0.001).

4.DISCUSSION

Pre-eclampsia continues to be a dreaded complication of pregnancy contributing a significant number to maternal mortality. Maternal hemodynamic adaptation begins in the 6to10 weeks gestation. Cardiac output increases and diastolic function is modified according to a rise in preload, a decreased after load, an increased compliance of the conduit vessels, ventricular remodelling, a modification of the renin-angiotensin-aldosterone system (Borghi et al., 2000).

Echocardiographic evaluation provides important information on both systolic and diastolic cardiac function. In particular, the analysis of transmitral flow patterns allows an evaluation of the diastolic left ventricular filling, whereas M-mode, 2D and Doppler echocardiography are used to assess systolic and morphological left ventricular modifications. Left ventricular Geometric pattern based on left ventricular mass and relative wall thickness of the left ventricle has gained interest in hypertensive disease(Bosio et al., 1999; Desai et al., 1996.).

Our purpose of this study was to investigate diastolic function and to gain insight into left ventricular structural changes in pregnancies complicated by Pre-eclampsia as compared with normotensive pregnant women as controls.

An attempt has been made to understand the relationship between profound heamodynamic changes and its association with pre-eclampsia through this prospective study

In the present study, the average systolic and diastolic blood pressure readings were compared in the two study groups and the following was observed. The mean systolic BP for pre-eclamptic women was 144 mm Hg, for normotensive pregnant was 114 mmHg .The difference in systolic blood pressure measurements between the two groups were statistically significant (P<0.001). (Table - 1)

The mean diastolic BP for pre-eclamptic women was 95mmHg, and for normotensive pregnant was 74mm Hg.

The difference in diastolic blood pressure between Group I Vs Group II, are statistically significant (Table - 1)

In our present study the mean arterial pressure of the subject with pre eclampsia was 112.04. higher than that of controls 87.83 (Table 2). This difference in Mean Arterial pressure in both study groups is statistically significant.

The two study populations selected were representative of different heamodynamic states, which was evaluated from the significant differences in mean blood pressure measurements and distribution of proteinuria. Patients with pre eclampsia showed higher blood pressure and increased rate of proteinuria versus the controls in normotensive pregnant groups These measurements of blood pressure and assessment of proteinuria allowed for differentiation in diastolic cardiac function between the study group and controls.

In our results, diastolic dysfunction is described in the pre - eclamptic patients through prolonged Isovolumetric Relaxation time and E/A ratio reversal.

Mitral inflow signal to assess diastolic dysfunction.

The most important modality to assess diastolic function is the mitral inflow signal. If permits us to determine the presence and severity of diastolic dysfunction.

The mitral inflow signal visualizes the individual phases of filing as well as displays the contribution of each individual phase in filling. As mitral inflow reflects the pressure difference between the atria and the ventricle, any abnormality of diastolic pressure (as in the presence of diastolic dysfunction) in the chambers will affect the velocity and shape of the Doppler inflow signal specifically, diastolic dysfunction alters the relationship between the early and late filling (E and A wave), and how long it takes for filling of the ventricle after the ventricle relaxes (length of the isovolemetric relaxation time – IVRT) .

In a study by Decont F et al (2003) PIH women showed diastolic dysfunction as assessed by E/A ratio and IVRT prolongation.

In a study by kyong Im cho et al (2005) 20 AN mothers with pre eclampsia and 20 normotensive pregnant women were included which concluded saying that left ventricular dysfunction in pre-eclampsia is mainly diastolic which is shown by Isovolemetric relaxation time.

In our present study also Early diastolic dysfunction as evidenced by E/A ratio reversal and IVRT prolongation is note..

In the present study 20% of patients have left ventricular diastolic dysfunction whereas 80% of patients in pre eclamptic group have no diastolic dysfunction. Diastolic dysfunction was determined in our study based on prolonged IVRT and reduced E/A ratio (Table (8)

Mode of delivery and heamodynamic dysfunction

In the present study we have taken E/A velocity and IVRT as the risk factors and assessed whether high risk pre-Eclamptic mothers influence the mode of delivery.

In the present study 45% of patients in normotensive group had normal vaginal delivery and 55% delivered by LSCS. Whereas in pre-eclamptic group only 25% of patients had normal vaginal delivery about 75 % of them delivered by LSCS (Table – 3).

From the present study it was inferred that chances of operative delivery was increased if the mother had profound heamodynamic alterations as in pre-eclampsia .

The increased incidence of operative delivery was because of the increased incidence of fetal distress and abnormal CTG probably due to poor placental function and oligohydramnios in pre-eclamptic group.)

Also it was inferred from our study that the rate of NICU admission was found to be increased in women with pre eclampsia compared to those of Normotensive pregnant women (Table – 5)

It has been that babies of pre-eclamptic women had higher rates of neonatal intensive care admission than normotensive group.

The NICU admission in the pre-eclamptic pregnancies was due to the pre-eclamptic changes in the placenta leading to placental insufficiency and oligohydramnios which increases the risk of intrapartum fetal hypoxia.
Birth weight in pre-eclamptic patients:

The mean birth weight in the present study sample was 2.544 kgs for pre-eclampatic group and 2.94 kgs for normotensive pregnancies (Table 4). In the present study the relationship between birth weight and pre-eclamptic hemodynamic alterations were statistically significant ($p<0.001$) with reduced mean birth weight in the babies born of pre-eclamptic mothers,

This difference in the mean birth weight between the two comparison groups was statistically significant.

Therefore it was calculated that marked alteration in hemodynamics of pregnant women was not only associated with pre-eclampsia but also resulted in increased fetal morbidity of statistical importance.

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5.CONCLUSION

1. Statistically significant number of patients had LV diastolic dysfunction.
2. Appropriate management of the patients who showed LV diastolic dysfunction prevented pulmonary edema and cardiac failure.

Clinical implications:

While overt cardiac failure associated with pre-eclampsia is rare, subclinical LV diastolic dysfunction is being increasingly recognized as in this study. Abnormal diastolic function is the most common cause of heart failure in patients with normal LV systolic function. This can be diagnosed by echocardiography with evidence of abnormal relaxation, increased filling pressure and decreased compliance as well as normal LV dimensions and preserved LV systolic function.

Pre-eclamptic patients with Grade 1 diastolic dysfunction are asymptomatic as long as the diastolic filling period is sufficiently prolonged to accommodate the delay in myocardial relaxation. The key to management is the prevention of tachycardia and control of factors that further aggravate diastolic dysfunction which include management of hypertension, control of obesity, management of diabetes mellitus if associated.

There is also a link between pre-eclampsia and future cardiovascular disease (Journal of Clinical Endocrinology and Metabolism Vol. 89; 2004). Women with a history of pre-eclampsia demonstrate altered expression of angiogenesis related proteins and increased insulin resistance more than one year post partum. These factors may contribute to their risk of future cardiovascular disease. Further studies are required addressing this issue.

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