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ASSESSMENT OF MATERNAL CARDIAC FUNCTION AND REMODELING IN WOMEN WITH PRE-ECLAMPSIA

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Conflicts of Interest: Nil

ABSTRACT:

Introduction: Pre-eclampsia is a multi system disorder which occurs after 20 weeks of pregnancy. Women with pre-eclampsia has diverse hemodynamic findings such as increased cardiac output, high vascular resistance and decreased myocardial contractility. Acute pre-eclampsia is associated with significant higher prevalence of asymptomatic abnormal global left ventricular functional geometry and myocardial injury leading to subsequent higher rise heart failure ischemic and hypertensive heart disease and related mortality compared with uneventful pregnancy in later life.[1,2] It is associated with maternal cardiac remodelling and biventricular diastolic dysfunction . In this study we evaluated and compared cardiac functions (systolic and diastolic) and remodelling and left ventricular strain in women with pre-eclampsia and healthy women by performing maternal echocardiography.

Materials and Methods: In this study 50 patient of each group (Healthy women & women with preeclampsia) are taken after informed consent. All subjects were subjected to standard 2-D doppler Transthoracic echocardiography at rest. Various parameters of study recorded. The data thus collected and were analysis.

Results: Systolic and diastolic parameters were jeopardized in pre eclamptic women as compared to the healthy women. The difference in longitudinal strain between the two groups was statistically significant. No significant change was observed between circumferential and radial strain.

Conclusion: There are structural and functional changes in the cardiovascular dynamics in subjects with Pre-eclampsia. Maternal echocardiography if introduced in routine management protocol could help to identify women who are at high risk to develop complications.

Keywords: Cardiac remodeling, Pre-eclampsia, Transthoracic echocardiography

1. Introduction

Pre-eclampsia is a multi-system disorder which occurs after 20 weeks of pregnancy. Women with pre-eclampsia have diverse hemodynamic findings such as increased cardiac output, high vascular resistance and decreased myocardial contractility. Acute pre-eclampsia is associated with significant higher prevalence of asymptomatic abnormal global left ventricular functional geometry and myocardial injury leading to subsequent higher rise heart failure ischemic and hypertensive heart disease and related mortality compared with uneventful pregnancy in later life.[1,2] It is associated with maternal cardiac remodeling and biventricular diastolic dysfunction . Pre-eclampsia and cardiovascular disease both has features of metabolic syndrome and atherosclerosis. They develop by common pathophysiologic pathway initiated by similar vascular risk factor. The vascular damage in pre-eclampsia may contribute to development of future cardiovascular disease or aggravate cardiovascular disease already present before pregnancy. Therefore prospective evaluation of these woman is referred to identify cardiovascular risk indicators and complications with eventual aim to offer the women the opportunity for primary prevention at relatively young age.[3] Majority of pre-eclampsia woman have stage B asymptomatic heart failure

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postpartum and 40% develop essential hypertension within 1-2 years after pregnancy.

One of the principle manifestations of this progress of change in geometry and function of left ventricle therapeutic intervention during asymptomatic phase of cardiac derangements can improve the long term prognosis more effectively than when commenced at symptomatic stage.

Trans thoracic echocardiography is non invasive precise device and validated in pregnancy. It is an ideal device for measuring cardiac functions in woman into pre-eclampsia however currently rarely used. Echocardiography provides information about disease etiology leads to accurate and non-invasive assessment of disease severity and is a powerful means of monitoring progression. The characteristic of pregnant woman made the use of transthoracic echocardiography easy and acceptable. However it is not routinely used.

M-Mode echocardiography can be used to measure circumferential strain at midway and measures of regional circumferential strain. STE provide more information than TDI allowing a non-invasive measurement of overall left ventricular strain and twist .This technique can provide new mechanism insight into systolic dysfunction in patient without structural cardiac alteration.

In nut shell there is significant functional structural changes in the cardiovascular dynamics in subjects with eclampsia. It appears BP monitoring alone is insufficient to identify efficiently the risk of cardiovascular complications in these subjects. Maternal echocardiography if introduced in routine management protocol could help to identify woman who are at high risk to develop complications. In this study we evaluated and compared cardiac functions (systolic and diastolic) and remodeling and left ventricular strain in women with pre-eclampsia and healthy women.

2. Material and Method :

This is a hospital based prospective & case control study conducted in S.M.S. Medical College in Department of Obstetrics and Gynecology at Jaipur. In this study 50 patient of each group (Healthy women & women with preeclampsia) are taken after applying the inclusion & exclusion criteria.

Inclusion Criteria:

Single ton pregnancy

Gestational age 34 weeks

Pre-eclampsia patients with no other medical illness.

Echocardiography was done by using Phillips 1.4.33 matrix echocardiography machine by single cardiologist. All subjects were subjected to standard 2-D Doppler Transthoracic echocardiography at rest . Various parameters of study recorded; Cardiac indices were normalized for body surface area, height and diastolic left ventricular short and long axis length, tissue doppler , strain and strain rate indices were given as absolute values. The data thus collected was subjected to statistical analysis.

3. Results :

Table 1: Demographic Variables

S. No.	Variables	PIH Group (Mean Values)	Control Group (Mean Values)	P-value
1.	Age (yrs)	25.44 ± 2	22.5 ± 3	0.238
2.	BMI (kg/m^2)	23.97 ± 3.4	21.86 ± 4.7	0.24

Table 2: *Systolic Parameters*

S. No.	Variables	PIH Group (Mean Values)	Control Group (Mean Values)	P-value
1.	LVEDV (ml)	75.71 ± 4.8	71.08 ± 5.6	0.001
2.	LVESV (ml)	33.75 ± 4.2	30.1 ± 3.7	0.02
3.	SV (ml)	59.83 ± 7.4	52.48 ± 6.4	0.002
4.	CO (l/min)	5.698 ± 0.013	5.665 ± 0.012	0.05
5.	ARD (cm)	2.188 ± 1.04	1.866 ± 1.06	0.002
6.	LVOT (cm)	2.37 ± 1.06	1.99 ± 1.08	0.06
7.	TVR (dynes/sec/cm^{-5})	1389 ± 57.04	1286 ± 45.01	0.001

Table 3: Diastolic Parameters

S. No.	Variables	PIH Group (Mean Values)	Control Group (Mean Values)	P-value
1.	E wave (m/sec)	1.2 ± 0.08	0.8 ± 0.02	0.001
2.	A wave (m/sec)	0.6 ± 0.02	0.4 ± 0.05	0.001
3.	E/A Ratio	1.29 ± 0.05	1.26 ± 0.04	0.08
4.	Edec Time (millisec)	200.9 ± 78	130.6 ± 87	0.001
5.	IVRT (millisec)	94.4 ± 8.9	84.7 ± 6.9	0.183
6.	EVTI (millisec)	12.67 ± 2.8	10.10 ± 1.9	0.467
7.	AVTI (millisec)	6.9 ± 0.01	5.1 ± 0.02	0.144
8.	S' (cm/sec)	7.87 ± 2.01	8.05 ± 1.99	0.67
9.	E' (cm/sec)	7.868 ± 0.05	9.667 ± 0.04	0.001

Table 4: *Strain Indices*

S. No.	Variables	PIH Group (Mean Values)	Control Group (Mean Values)	P-value
1.	Longitudinal Strain	14.3 ± 2.01	18.31 ± 1.8	0.001
2.	Circumferential Strain	18.31 ± 1.27	19.8 ± 1.26	0.35
3.	Radial Strain	21.3 ± 2.04	20.01 ± 1.06	0.45

100 Women were included in study of which 50 were Pre-eclamptic and 50 were normal pregnant females. All were subjected to 2D Echo and TDI. The mean age of PIH group was 25.4 years ± 2 years versus 22.5 ± 3 years in control group.PIH women showed a higher BMI 23.97±3.4 Kg/m^2 as compared to control with 21.86± 4.7 Kg/m^2. (Table No.1)

Mean LVEDV (75.71±4.8 ML) ,Mean Stroke volume (59.63±7.4 ML)and Aortic root diameter of 2.188±1.04 cm were found to be higher in PIH group and these difference were statistically significant when compared to control group with mean LVEDV of 71.08± 5.8 ML; mean SV of 52.48± 6.4 ML/min and mean ARD 1.866±1.06 CM respectively .Also mean TVR in PIH group was higher (1385± 57.04 dynes /sec/m_5 V/S 1286±4.50dynes/sec/m_5) as compared to control group and it was statistically significant . 44% PIH group had CO between 5.6-6 L/min where as only 20% of control group had CO in this range making it statistically significant (mean cardiac output 5.69±0.132L/min versus 5.6±0.012L/min). Majority of PIH women 82%has LVESV >35 ML and 50% of control had <30 ml (Mean 33.75 ±4.2 ml V/S 30.1± 3.7 ml) .(Table no.2)

In diastolic parameter, significant values were obtained as Mean E wave was higher in PIH group as to controls(1.2±0.08m/sec versus 0.8±0.02m/sec). similarly A wave was >0.5 m/sec in 76% of PIH group as to control mean (mean A wave 0.6±0.02m/sec versus 0.4±0.05 m/sec).(Table no.3)

Similarly mean E/A ratio was higher in PIH group but p value was not significant (1.29±0.005 versus 1.26±0.04). In majority of PIH women(58%) E dec time was between 180-220 millisecond as to control group in which 54?% women had E dec between 100-110 millisecond and data was statistically significant. Mean IVRT, mean EVTI and mean AVTI were high in PIH group as compared to control group though the p value was not significant (94.4±8.9 millisecond versus 84.7±6.9 millisecond; 12.6±2.8 millisecond versus 10.10±1.9 millisecond; 6.9±0.01 millisecond versus 5.1±0.02millisecond respectively)

The difference in longitudinal strain between the two groups was statistically significant. No significant change was observed between circumferential and radial strain.(Table no.4)

4. Discussion

The hemodynamic disorder of Pre Eclampsia represent a very interesting model in which pressure overload develops in few weeks which may induce cardiac changes similar to that detected in chronic arterial hypertension which is characterized by long lasting pressure overload . Modern echocardiography technique utilizes Doppler echocardiography and enables the determination of velocity changes within the cardiac cycle. Mean LVEDV evaluation in PIH groups as compared to in control group (75.7±4.8 ml v/s 71.08 ±5.6 ml) it was statistically significant. Similar results were obtained by Dennis et al[4] in which they studied the cardiovascular hemodynamic in preeclamptic and normotensive population. Also Rizwana solanki [5]et al and Chahinda Ghossin et al[6] had similar results supporting our study .

Mean LVESV was higher in PIH women as compared to normotensive female and significant data was obtained. Our results were comparable to results obtained by Solanki Rizwana[5] et al. Similarly stroke volume,cardiac output , aortic root diameter and total vascular resistance is higher in PIH women as compared to women with normal BP.

Our results were similar and comparable to those with Dennis et al[4], Easterling TR et al[7] , Solanki Rizwana et al[5] in all parameters . Mean LVOT diameter was slightly higher in PIH group as compared to controls although P Value also was not significant.

During pregnancy the heart undergoes remodeling with increase in chamber dimensions, left ventricular wall thickness and mass that is consistent with a process of eccentric hypertrophy. Mean E wave and a wave were higher in pre eclamptic group as compared to control and values were significant. But mean E/A ratio, P value was not significant though the values in cases are more than controls. Our study was similar to Solanki Rizwana[5] et al in these parameters . Mean E dec was found to be higher in PIH group as compared to control. Our results are comparable to study done by Lesa M Bodwiner[8] et al .

Though mean IVRT, mean EVTI and AVTI are higher in PIH group as compared to controls but the data obtained had insignificant P-values.

Speckle tracking echocardiography measures overall LV strain and twist and therefore provide new mechanistic insight into systolic dysfunction in patient without structural cardiac alteration. Data obtained by STE showed statistically significant data in terms of longitudinal strain in PIH group as compared to controls. But the p Values was insignificant in both circumferential and radial strains. Our study was supported the study done by Sajid Shahul[9] et al.

5. Conclusion :

Preeclampsia is a multi system disease with acute onset of cardiovascular manifestation. Tissue Doppler indices are very sensitive in picking early myocardial strain and are related to acute complications and long term risk of cardiovascular morbidity. Hence provide an opportunity for early cardiovascular risk stratification and introduction of prophylactic strategies.

Strain echocardiography with speckle tracking which helps to detect subclinical LV dysfunction. But whether this early subclinical dysfunction detection has long term implication needs to be evaluated.

Since these are structural and functional changes in the cardiovascular dynamics in subjects with Pre eclampsia. Maternal echocardiography if introduced in routine management protocol could help to identify women who are at high risk to develop complications.

6. Abbreviations:

ARD: Aortic Root Diameter

AVTI: A Wave Velocity Time Integral

EVTI: E Wave Velocity Time Integral

IVRT: Intra Volumetric Relaxation Time

LVEDV: Left Ventricular End Diastolic Volume

LVESV: Left Ventricular End Systolic Volume

LVOT: Left Ventricular Outflow Tract

STE: Speckle Tissue Echocardiography

TDI: Tissue Doppler Imaging

TVR: Total Vascular Resistance

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